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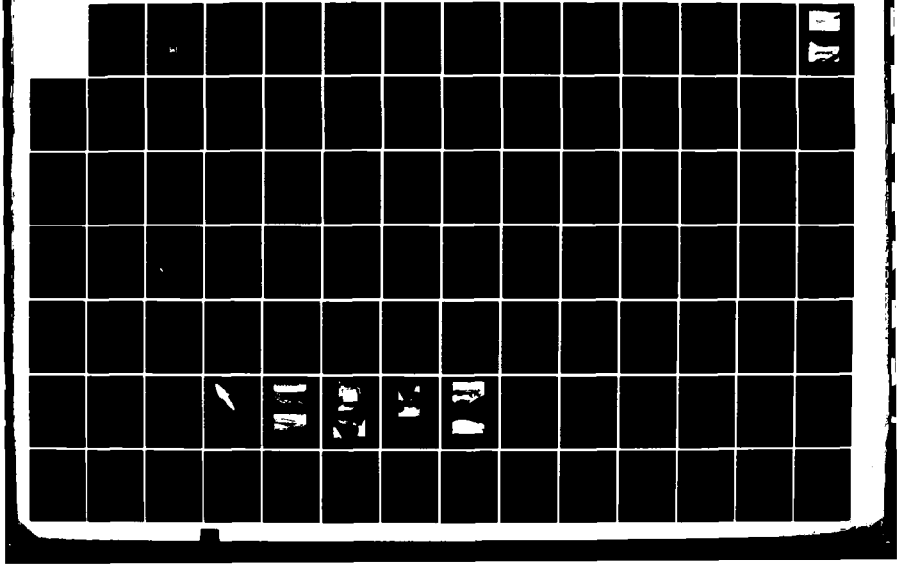
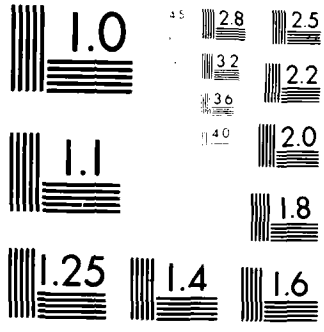


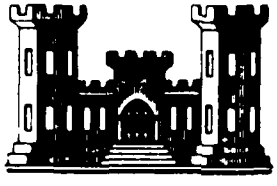


MICROCOPY RESOLUTION TEST CHART

MERRIMACK RIVER BASIN
WILTON, NEW HAMPSHIRE

SOUHEGAN RIVER WATERSHED
DAM NO. 33
NH 00265
NHWRB 254.34

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

AUGUST 1979

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7 AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8 CONTRACT OR GRANT NUMBER(s)
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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Merrimack River Basin
Wilton, New Hampshire
King Brook, a Tributary of Stony Brook (tributary of the Souhegan River)

20 ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is an earth embankment dam 510 ft. long and 21 ft. high. It is small in size with a high hazard potential. The dam is in good condition at the present time. There are remedial measures to be undertaken by the owner. A program of annual technical inspections should be continued. No conditions were observed which require further investigation.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

NEDED

Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

Inclosed is a copy of the Souhegan River Watershed Dam No. 33 Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire and the owner.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely,

WM. E. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

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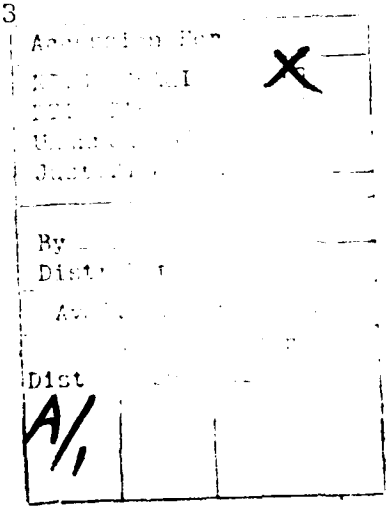
SOUHEGAN RIVER WATERSHED DAM NO. 33
NH 00265



MERRIMACK RIVER BASIN
HILLSBOROUGH COUNTY, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

PHASE I REPORT

Identification No.:	NH 00265
NHWRB No.:	254.34
Name of Dam:	SOUHEGAN RIVER WATERSHED DAM NO. 33
Town:	Wilton
County and State:	Hillsborough County, New Hampshire
Stream:	King Brook, a tributary of Stony Brook (a tributary of the Souhegan River)
Date of Inspection:	May 14, 1979

BRIEF ASSESSMENT

The Souhegan River Watershed Dam No. 33 is located on King Brook in Wilton, New Hampshire. The dam is an earth embankment 510 feet long and 21 feet high with a drop inlet service spillway structure and a 30 inch outlet conduit. An earth emergency spillway 102 feet wide is cut into the left abutment.

The dam is owned by the New Hampshire Water Resources Board. It was designed by the Soil Conservation Service for the purpose of flood protection in the Souhegan River Watershed.

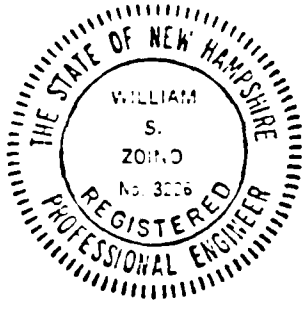
The drainage area of the dam covers 1.0 square mile and is made up primarily of rolling woodland. The dam impounds only 24 acre-feet at low stage but has a maximum impoundment of 900 acre-feet. The dam is SMALL in size and its hazard classification is HIGH since significant property damage and loss of life could result in the event of a dam failure.

The test flood for this dam is the Probable Maximum Flood. The peak inflow for this flood is 2,125 cfs. Because of storage, the resulting peak discharge is 1,080 cfs compared to a total spillway capacity of 2100 cfs. The water surface would be at elevation 696.7 feet (MSL) or 1.5 feet below the top of the dam for this flood.

The dam is in GOOD condition at the present time. Remedial measures to be undertaken by the owner include: filling in animal burrows on slopes, mowing of slopes, removing debris from trash racks; including annual operation of drain gate in the inspection procedure; and developing a formal, written, emergency warning system for the dam. The program of annual technical inspections should be continued.

No conditions were observed which require further investigation.

7. The remedial measures outlined above should be implemented within two years of receipt of this report by the owner.



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Engineering Division

APPROVAL RECOMMENDED:

Jack B. Frazier

[illegible]

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the Test Flood should not be interpreted as necessarily posing a highly inadequate condition. The Test Flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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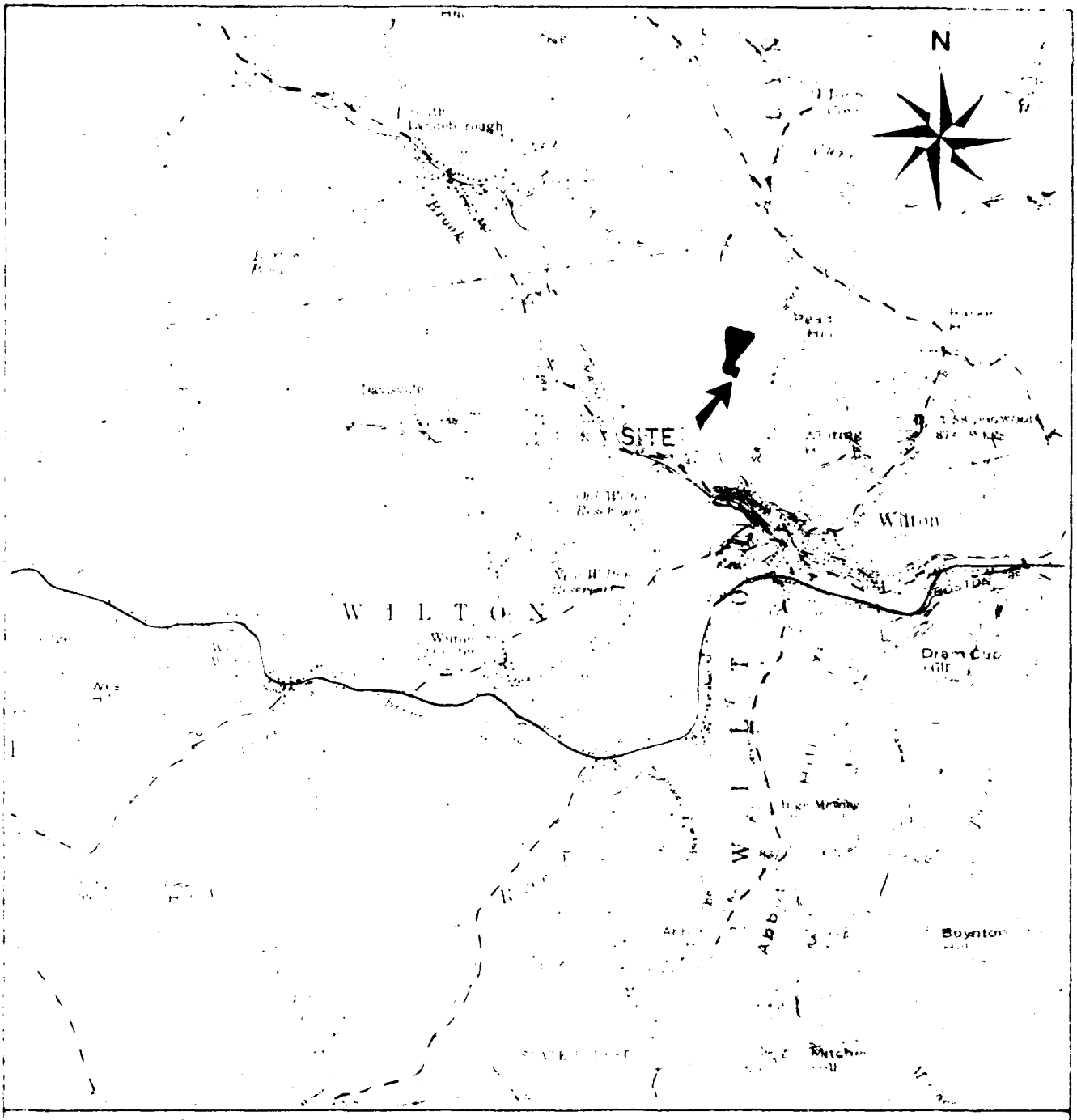
Overview photo from left side

Overview photo of downstream slope



SCALE

MILES

FROM U.S. GEOLOGICAL SURVEY PETERBOROUGH, N.H. 9
MILFORD, N.H. 7½ QUADRANGLE
MAPS

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC. INC.
GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

LOCUS PLAN

30 SOUHEGAN RIVER WATERSHED
DAM No. 33
NEW HAMPSHIRE

FILE NO. [illegible]

			SCALE AS NOTED
			DATE [illegible]

PHASE I INSPECTION REPORT

SOUHEGAN RIVER WATERSHED DAM NO. 33

SECTION 1

PROJECT INFORMATION

1.1 General

(a) Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Goldberg, Zoino, Dunnicliff & Associates, Inc. (GZD) has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to GZD under a letter of March 30, 1979 from Colonel John P. Chandler, Corps of Engineers. Contract No. DACW 33-79-C-0058 has been assigned by the Corps of Engineers for this work.

(b) Purpose

1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-federal dams.

3) Update, verify, and complete the National Inventory of Dams.

(c) Scope

The program provides for the inspection of non-federal dams in the high hazard potential category based upon location of the dams, and those dams in the significant hazard potential category believed to represent an immediate danger based on condition of the dams.

1.2 Description of Project

(a) Location

The Souhegan River Watershed Dam No. 33 is located approximately 7900 feet upstream of Stony Brook in Wilton, New Hampshire. It can be reached from Dale Street which intersects State Route 31 in Wilton, New Hampshire. The dam is shown on the USGS, Peterborough, New Hampshire quadrangle, at approximate coordinates: N 42° 51.6', W 71° 45.0'. (See location map on page v). Page B-2 of Appendix B is a site plan for this dam.

(b) Description of Dam and Appurtenances

The dam consists of: an earth embankment with an earthfill cutoff trench below the embankment; a principal spillway with a reinforced concrete riser, outlet pipe, and impact basin; and an emergency spillway 102 feet wide, located at the left abutment. The dam is 510 feet long.

1) Embankment (See pgs. B-3 through B-10)

The embankment was constructed primarily of silty sand with clay and gravel (Designation SC-SM using the Unified Soil Classification System). It is 510 feet long and is a maximum of 24 feet high. The upstream and downstream slopes are 3 horizontal to 1 vertical; and the width of the crest is 12 feet.

Beneath the embankment is an earthfill cutoff trench of variable bottom width. According to available plans, it was constructed of the same silty sand material as the embankment. The cutoff trench was designed and constructed to extend through sand and gravel layers to firm bedrock or glacial till.

There is a berm approximately 10 feet wide on the upstream slope at approximately normal pool elevation (681.0 ft. MSL). The purpose of this berm is wave erosion protection.

2) Principal Spillway (See pgs. B-5 & B-9)

The principal spillway consists of a reinforced concrete drop inlet structure with a sluice gate controlled inlet pipe and two uncontrolled orifice inlets, a 30 inch diameter outlet pipe supported on a concrete cradle, and an impact basin.

The riser structure is 17 feet high and 9.2 feet wide normal to the axis of the dam. It is 4.2 feet long parallel to the embankment and flares to 14.2 feet long at the top. The walls of the structure are 10 inches thick and the top slab is 8 inches thick.

At the base of the structure is a 12 inch diameter, vertical lift, sluice gate inlet which is controlled by a crank operated bench stand with a rising stem. A 12 inch diameter, cast iron pipe extends 15 feet upstream from the lift gate into the impoundment pool. Plans indicate an animal guard has been installed at the upstream end of this pipe.

The "low stage inlet" is an uncontrolled opening approximately 3 feet above the sluice gate invert. It is one foot, 6 inches wide and 7 inches high and is located in the upstream face of the riser structure. The water flows over this orifice and drops into the riser structure. It is protected by a trash rack assembly approximately 5.5 feet high and 4 feet, 2 inches wide. This assembly is fabricated from galvanized steel angle sections.

The "high stage inlet" consists of two openings approximately 13 feet, 9 inches above the sluice gate invert. They are 7.5 feet wide and 15 inches high and are located in the left and right sides of the flared portion of the riser structure. They are protected by a galvanized steel grating 2.5 inches high placed in front of each high stage opening and 5 galvanized steel angles placed in the sloping section below each opening. A 30 inch diameter manhole permits access into the riser structure.

The riser structure is drained by a 30 inch diameter reinforced concrete pressure pipe. It is approximately 115 feet long and drops approximately 2 feet over that length. The pipe penetrates the downstream side of the riser structure and is supported by a 4 inch thick concrete cradle within the embankment. Plans indicate 4 concrete anti-seep collars cast around the pipe within the embankment.

3) Emergency Spillway (See pgs. B-3 & B-5)

The earth emergency spillway was excavated in the left abutment. It curves to the right around the embankment and is 102 feet wide at the control section. It is approximately 500 feet long and lies approximately 4.4 feet below the top of the embankment. The side slopes are 3 horizontal to 1 vertical.

4) Foundation and Embankment Drainage (See pgs. B-7 & B-8)

A 4 foot wide trench drain of clean sand and gravel exists beneath the full length of the downstream slope of the embankment. It contains two 6 inch perforated asbestos cement pipes. One extends 32 feet to the left of the outlet conduit, and the other extends 176 feet to the right of the outlet conduit. These pipes discharge through the wing walls of the impact basin on either side of the principal spillway outlet conduit.

(c) Size Classification

The dam's maximum impoundment of 900 acre feet and height of 21 feet place it in the SMALL size category according to the Corps of Engineers' Recommended Guidelines.

(d) Hazard Potential Classification

The hazard potential classification for this dam is HIGH because of the significant economic losses and the potential for loss of life downstream in the event of dam failure. Section 5 of this report presents more detailed discussion of the hazard potential.

(e) Ownership

The dam is owned by the New Hampshire Water Resources Board, 37 Pleasant Street, Concord, New Hampshire 03301. They can be reached by telephone at area code 603-271-3406.

(f) Operator

The operation of the dam is controlled by the New Hampshire Water Resources Board. Key officials are as follows:

George McGee, Chairman
Vernon Knowlton, Chief Engineer
Donald Rapoza, Assistant Chief Engineer

The Board's telephone number is 603-271-3406. Alternatively, the Board can be reached through the state capital at 603-271-1110.

(g) Purpose of the Dam

The purpose of the dam is to reduce downstream flooding by providing temporary storage for the runoff from 1.0 square miles of watershed. This temporary storage is released through the low and high stage inlets of the principal spillway.

(h) Design and Construction History

The dam was designed by the U.S. Department of Agriculture, Soil Conservation Service in conjunction with the New Hampshire Water Resources Board. It was completed in 1973.

(i) Normal Operating Procedure

The dam is self regulating. The pond drain gate is operated only as part of infrequent maintenance checks.

1.3 Pertinent Data

(a) Drainage Area

The drainage area for this dam covers 1.0 square mile. It is made up primarily of rolling woodland with some pasture and minor development.

(b) Discharge at Damsite

1) Outlet Works

Normal discharge at the site is through the 30 inch diameter outlet pipe. In the event of severe flooding water would flow over the emergency spillway at elevation 693.8 feet (MSL). The invert of the low stage orifice is at elevation 681.0 feet (MSL). The invert of the high stage orifice is at elevation 691.7 feet (MSL).

2) Maximum Known Flood

There is no data available for the maximum known flood at this damsite.

3) Ungated Spillway Capacity at Top of Dam

The capacity of the principal spillway with the reservoir at top of dam elevation (698.2 feet MSL) is 100 cfs. The capacity of the emergency spillway is 2000 cfs at this level.

4) Ungated Spillway Capacity at Test Flood

The capacity of the principal spillway with the reservoir at test flood elevation (696.7 feet MSL) is 95 cfs. The capacity of the emergency spillway is 985 cfs at this level.

5) Gated Spillway Capacity at Normal Pool

There are no gated spillways with the exception of the gated pond drain inlet which is normally closed.

6) Gated Spillway Capacity at Test Flood

As previously mentioned, there are no gated spillways.

7) Total Spillway Capacity at Test Flood

The total spillway capacity at test flood elevation (696.7 feet MSL) is 1080 cfs.

8) Total Project Discharge at Test Flood

The total project discharge at test flood elevation (696.7 feet MSL) is 1080 cfs.

(c) Elevation (feet above MSL)

1) Streambed at centerline of dam: 677.6

2) Maximum tailwater: Unknown

3) Upstream portal invert diversion tunnel: Not applicable.

4) Normal pool: 681.0

5) Full flood control pool: 693.8

6) Spillway crest:

a) Pond drain inlet: 678.0

b) Low stage inlet: 681.0

c) High stage inlet: 691.7

d) Emergency spillway: 693.8

7) Design surcharge: 695.4

8) Top dam: 698.2

9) Test flood design surcharge: 696.7

(d) Reservoir

1) Length of maximum pool: 5300 ± ft.

2) Length of normal pool: 920 ± ft.

3) Length of flood control pool: 5200 ± ft.

(e) Storage (acre feet)

1) Normal pool: 24

2) Flood control pool: 450

3) Spillway crest pool:

a) Low stage inlet: 24

b) High stage inlet: 296

c) Emergency spillway: 450

4) Top of dam: 900

5) Test flood pool: 736

(f) Reservoir Surface (acres)

1) Normal pool: 12

2) Flood control pool: 87

3) Spillway crest pool:

a) Low stage inlet: 12

b) High stage inlet: 62

c) Emergency spillway: 87

4) Test flood: 107

5) Top of dam: 115

(g) Dam

1) Type: Earth embankment

2) Length: 510 ft.

3) Height: 21 ft.

4) Top width: 12 ft.

5) Side slopes: Upstream: 3 to 1
Downstream: 3 to 1

6) Zoning: Homogeneous, semi-pervious silty sand with clay and gravel

7) Impervious core: None

8) Cutoff: Variable width, earthfill

9) Grout curtain: None

(h) Diversion and Regulating Tunnel

Not applicable

(i) Spillways

1) Type:

a) Principal spillway: Reinforced concrete drop inlet with a 30" outlet pipe

b) Emergency spillway: Grass covered earth channel cut in left abutment

2) Length of weir:

a) Pond drain inlet: 12 inch diameter pipe

b) Low stage inlet: 18 inches

c) High stage inlet: 15 ft.

d) Emergency spillway: 102 ft.

3) Crest Elevation (ft. above MSL)

a) Pond drain inlet: 678.0

b) Low stage inlet: 681.0

c) High stage inlet: 691.7

d) Emergency spillway: 693.8

4) Gates: 12 inch vertical lift sluice gate on pond drain inlet

5) Upstream channel: Reservoir

6) Downstream channel: narrow channel to 30 inch reinforced concrete pipe under road

(j) Regulating Outlet

The only regulating outlet is a 12 inch diameter pipe controlled by a wheel operated sluice gate. The pipe invert is at elevation 678.0 feet (MSL). The purpose of this outlet is pond drainage, and it is normally closed.

SECTION 2 - ENGINEERING DATA

2.1 Design Data

Among other design data available from the Soil Conservation Service are hydrologic and hydraulic computations, structural computations, a geological report and soils laboratory test results. This information was used extensively in computations presented in section 5 and Appendix D of this report.

2.2 Construction Data

"As built" plans are available for this dam and show good agreement with the design plans and the visual inspection.

2.3 Operational Data

No operational data is available as the dam is self regulating.

2.4 Evaluation of Data

(a) Availability

Sufficient data is available to permit an evaluation of the dam when combined with findings of the visual inspection.

(b) Adequacy

There is sufficient design and construction data to permit an assessment of dam safety when combined with the visual inspection, past performance, and sound engineering judgment.

(c) Validity

Since the observations of the inspection team generally confirm the available data, a satisfactory evaluation for validity is indicated.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

(a) General

The Souhegan River Watershed Dam No. 33 is in GOOD condition at the present time.

(b) Dam

1) Earth Embankment (See overview photos)

Three to five small animal burrows were found in the left upstream slope to the left of the riser structure. The upstream slope is not protected by riprap, but is in good condition. There is debris on the upstream slope.

The toe drains were completely submerged at the time of inspection due to high tailwater.

2) Emergency Spillway (See photos 1 & 2)

The emergency spillway is in good condition. There are wet spots in the channel but these are caused by natural groundwater or ponded runoff. There is a stone drain trench system in the downstream end of the emergency spillway. This system was added in 1977.

(c) Appurtenant Structure

1) Drop Inlet Service Spillway Structure (See photos 3, 4 and 5)

The structure is in good condition with some minor open horizontal construction joints and honeycombed concrete. The sluice gate bench stand is in good condition. The hand crank has been removed from the site to prevent unauthorized use. The trash racks are in good condition but are clogged with debris.

2) Pond Drain Inlet Pipe

At the time of inspection the 12 inch pond drain inlet pipe was completely submerged and could not be observed.

3) Outlet Conduit (See photo 7)

The downstream end of the outlet pipe is in good condition with no evidence of spalling, cracking, or efflorescence.

4) Impact Basin (See photo 6)

This structure is generally in good condition. There is some efflorescence on both ends of the top surface of the baffle wall and some minor erosion and staining of the headwall. There is no safety fence around this structure.

(d) Reservoir Area

The shore of the reservoir is generally shallow sloping woodland. It appears stable and in good condition.

(e) Downstream Channel

The downstream channel is a narrow channel to a 30 inch diameter concrete conduit under Dale Street.

3.2 Evaluation

The dam and its appurtenant structures are generally in GOOD condition. The potential problems observed during the visual inspection are listed as follows:

a) Animal burrows on slopes.

b) Debris on upstream slope and in low stage trash racks.

c) Lack of safety fence around impact basin.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

No written operational procedures were disclosed. The dam is self regulating.

4.2 Maintenance of Dam

An annual inspection is made jointly by the New Hampshire Water Resources Board and the Soil Conservation Service. Recommendations resulting from this inspection are implemented by the NHWRB.

4.3 Maintenance of Operating Facilities

Operation of the sluice gate for the pond drain inlet is checked approximately once every four or five years by NHWRB.

4.4 Description of Warning System in Effect

There is no warning system in effect.

4.5 Evaluation

The established operational procedures for this dam are generally satisfactory. Additional emphasis on routine maintenance will assist the owners in assuring the long-term safety of the dam. A formal, written, downstream emergency warning system should be developed for this dam.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features

(a) General

Souhegan River Watershed Dam No. 33 is a Soil Conservation Service (SCS) flood control dam on a tributary of Stony Brook in Wilton, New Hampshire. The dam is about 4000 feet upstream of the confluence of the tributary and Stony Brook, and about 2 miles upstream of the confluence of Stony Brook and the Souhegan River. The upstream drainage area is 1.0 square mile of rolling topography.

The dam itself is a 510 foot long earthen embankment with a grass-lined emergency spillway 102 feet wide. The principal spillway consists of three orifices located on a concrete riser in the reservoir. Flow from the orifices proceeds under the dam through a reinforced concrete pipe.

(b) Design Data

The data sources available for Souhegan River Watershed Dam No. 33 include the Soil Conservation Services's (SCS) "Hydrology and Hydraulics" Design Calculations. These calculations include Storage-Elevation and Stage-Discharge curves for the dam, and the routing of storms of various magnitudes through the reservoir. These calculations are dated 1960 through 1968.

The SCS established the elevation of the low flow outlet (681 feet MSL) at the level of the pool which existed before the dam was built. The elevation of the two high stage outlets (691.7 feet MSL) was established above the 100-year flood stage in the reservoir in order to take advantage of the large natural storage at the site and to allow a low release rate at the 100-year flood stage. The emergency spillway crest is at elevation 693.8 feet (MSL) and the dam crest is at elevation 698.2 feet (MSL).

Also available for this dam is an SCS "Maintenance Checklist" report for an inspection dated June 2, 1977.

The Soil Conservation Service Design plans, dated 1971, are also available for this dam.

(c) Experience Data

No records of flow or stage are known to be available for Souhegan River Watershed Dam No. 33.

(d) Visual Observations

The emergency spillway is a 102 foot wide grass-lined channel, with its crest at elevation 693.8 feet (MSL) and with 3:1 side slopes. The flow from this spillway rejoins the brook almost immediately downstream of the dam. The principal spillway consists of a concrete riser structure in the reservoir with three orifices. The flow from these orifices combines in the riser and flows under the dam to the brook through a 30 inch reinforced concrete pipe 114.9 feet long. The brook flows under Dale Street about 100 feet downstream of the principal spillway outlet. Dale Street is an embankment with its crest at about 681.5 feet MSL and a 30 inch diameter culvert.

Downstream of the dam the brook flows about 4000 feet down a steep hill to Stony Brook. The development in this reach includes a small bridge on a dirt road and a farm building about 2500 feet downstream of the dam. About 3800 feet downstream of the dam (200 feet upstream of Stony Brook) there is a house about 6 to 7 feet above the streambed. Just upstream of Stony Brook, the stream passes under New Hampshire Highway 31, a heavily-travelled road, through a 48 inch culvert.

After the confluence, the combined flows of the tributary and Stony Brook continue downstream about 4000 feet to the town of Wilton. The brook parallels New Hampshire Highway 31 in this reach.

Just outside of Wilton there is a group of about ten houses, an apartment, and a laundry between New Hampshire Highway 31 and Stony Brook. The ground floors of these structures range from 7 to 18 feet above the streambed. The gradient of Stony Brook flattens out in this reach, and in the middle of the town of Wilton the Brook flows over Abbott Memorial Trust Dam and joins the Souhegan River.

The Souhegan River flows through Wilton, and has 5 to 10 residences and industrial buildings on its banks there. Below Wilton the Souhegan runs through about a 5 mile reach with a wide flood plain before reaching Milford, New Hampshire.

(e) Test Flood Analysis

The hydrologic conditions of interest in this Phase I investigation are those required to assess the dam's overtopping potential and its ability to safely allow an appropriately large flood to pass. This requires using the discharge and storage characteristics of the structure to evaluate the impact of an appropriately sized Test Flood. The original hydraulic and hydrologic design calculations of the SCS are available for this dam.

Guidelines for establishing a recommended Test Flood based on the size and hazard classification of a dam are specified in the "Recommended Guidelines" of the Corps of Engineers. The impoundment of less than 1000 acre feet and the height of less than 40 feet classify this dam as a SMALL structure.

The appropriate hazard classification for this dam is HIGH because of the significant economic losses and potential for loss of life downstream in the event of dam failure. As shown in the Dam Failure Analysis section, the increase in flooding caused by failure would pose a threat to property and to lives in the village of Wilton and at other locations along Stony Brook and the Souhegan. Other impacts of dam failure include damage to a heavily traveled highway and to several small roads (see Dam Failure Analysis section).

As shown in Table 3 of the Corps of Engineers' "Recommended Guidelines", the appropriate Test Flood for a dam classified as SMALL in size with a HIGH hazard potential would be between one half times the probable maximum flood (PMF) and the PMF. Where a range of possible inflows is suggested, the Corps of Engineers' "Recommended Guidelines" advise using the inflow most closely relating to the dam's hazard potential. Since the hazard potential is on the high side of HIGH, the Test Flood inflow is the PMF. As part of their hydrologic design calculations for the dam, the SCS created a "Freeboard Hydrograph" (approximately equivalent to the PMF). Their peak inflow is 1728 cfs, which is 1728 csm on the one square mile drainage area. This compares to the 2125 csm given on the Corps of Engineers' "Maximum Probable Peak Flow Rates" curve assuming rolling topography.

The Corps' peak inflow of 2125 cfs is more conservative and is therefore selected as the test flood for this dam. Use of the Corps' suggested methodology for determining attenuation by storage results in a peak outflow of 1080 cfs, with the water surface at 696.7 feet MSL, 1.5 feet below the dam crest and 15.7 feet above normal pool.

This analysis assumes that the reservoir elevation is 690.5 feet (MSL) at the start of the storm. The drawdown time from the emergency spillway crest to normal pool is 10 days.

(f) Dam Failure Analysis

The peak outflow that would result from the failure of Souhegan River Watershed Dam No. 33 is estimated using the procedure suggested in the Corps of Engineers New England Division's April 1978 "Rule of Thumb Guidelines for Estimating Downstream Dam Failure Hydrographs", as clarified in a December 7, 1978 meeting at the Corps' Waltham office. Normally this procedure is carried out with dam failure assumed to occur when the water surface reaches the top of the dam. In this case, however, the outflow of 2100 cfs with the water surface at the top of the dam (698.2 feet MSL) is greater than the Probable Maximum Flood (PMF) routed outflow at the dam. Also, this outflow would create flooding downstream prior to dam failure. Failure is therefore assumed to occur with the water surface at the SCS Design High Water of 695.4 feet MSL, 2.8 feet below the top of the dam.

The discharge just prior to failure at this elevation is given by the Stage-Discharge curve developed in Appendix D as 414 cfs. The tailwater elevation prior to failure at this discharge is estimated to be 682 feet MSL.

For an assumed breach width equal to 40 percent of the dam width at the half-height, the gap in the embankment due to failure would be 82 feet. The resulting increase in flow would be 6763 cfs or a total of about 7180 cfs.

This peak dam failure flow would severely overtop Dale Street, just downstream of the dam. It would also overtop the bridge 2400 feet downstream and flood the farm building at this bridge.

The first major development impacted would be a house about 6 feet above the streambed 3800 feet downstream of the dam. The attenuated peak dam failure flow

of 6880 cfs would increase flow depth from 2 feet to 9 feet, and would cause 2 to 3 feet of flooding at the house. This would cause serious damage at the house, and pose a threat of loss of life.

Just upstream of the confluence of the tributary and Stony Brook, the tributary passes under New Hampshire Highway 31 through a 48 inch culvert. Dam failure would increase the flow over the top of Highway 31 from about 325 cfs to about 6800 cfs. The increased flow would probably severely damage or destroy the Highway 31 embankment at this point.

After the tributary joins Stony Brook, Stony Brook parallels U.S. Highway 31 for about 4000 feet to the town of Wilton. There is no development in this reach except the highway, which is above dam failure flows.

Just outside of Wilton there are a number of houses along the banks of Stony Brook. There are 9 houses 7 to 12 feet above the streambed, and 1 house about 18 feet above the streambed. There is also an apartment building 12 feet above the streambed and a laundry about 10 feet up. Highway 31 parallels the brook about 10 feet above the streambed, and there are numerous dwellings and commercial establishments on the other side of the highway about 20 to 25 feet above the streambed.

The assumed pre-failure flow of 900 cfs (assuming 500 cfs of inflow from Stony Brook) would create a stage of 6 feet in this reach. The dam failure outflow of 6250 cfs would yield a stage of about 13 feet on Stony Brook, which would cause serious flooding in this reach.

Downstream of the residences and still in the town of Wilton, Stony Brook passes over Abbot Memorial Trust Dam and flows into the Souhegan River. The flow of about 6250 cfs could create flooding on the Souhegan in Wilton along which 5 to 10 houses and businesses are located. Downstream of Wilton the Souhegan flows through about 5 miles of broad flood plain before reaching the town of Milford. It is expected that the dam failure outflow would be essentially attenuated in this reach.

The following chart summarizes the downstream impacts of the failure of Souhegan River Watershed Dam No. 33.

IMPACT OF DAM FAILURE CHART

Location # (Map, P. D-25)	Location	# of Dwellings	Level Above Streambed (ft)	Flow and Stage Before Failure	Flow and Stage After Failure	Comments
-	Tailwater	-	-	411 cfs 682' MSL	7180 cfs -	Dale Street overtopped
1	Highway 31, house, Stony Brook	1	6-7	411 cfs 2 ft.	6880 cfs 9 ft.	Some danger of loss of life. Highway 31 severly overtopped.
2	Houses at Wilton	9 2 1 apt. house 1 laundry	7 18 12 10	900 cfs	6250 cfs	Danger of loss of life. Highway 31 severely (3') overtopped.
3	Souhegan River Junction	-	-	900 cfs	6250 cfs	
	Souhegan River Downstream	10-15	varies	-	-	Possible flood damage.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

(a) Visual Observations

There has been no significant displacement or distress which would warrant the preparation of structural stability calculations.

(b) Design and Construction Data

1) Embankment

No records of an embankment slope stability assessment are available for this dam.

2) Principal Spillway Structures

A review of the structural calculations for the design of the drop inlet service spillway structure and the outlet conduit (principal spillway) revealed that these structures have been designed on the basis of sound engineering practice.

(c) Operating Records

There are no known operating records for this dam.

(d) Post Construction Changes

A system of stone drainage trenches was added to the downstream end of the emergency spillway in 1977. This construction is not related to structural stability. With this exception there have been no construction changes disclosed.

(e) Seismic Stability

The dam is located in seismic zone No. 2 and, in accordance with the recommended Phase I guidelines, does not warrant seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

(a) Condition

The dam and its appurtenances are generally in good condition at the present time.

(b) Adequacy of Information

There is sufficient design and construction data to permit an assessment of dam safety when combined with the visual inspection, past performance, and sound engineering judgment.

(c) Urgency

The remedial measures described herein should be implemented by the owner within two years of receipt of this phase I Inspection Report.

(d) Need for Additional Investigations

None

7.2 Recommendations

No conditions were observed which warrant further investigation.

7.3 Remedial Measures

It is recommended that the owner institute the following remedial measures:

1) Check the operability of the pond drain inlet gate as part of the annual inspection procedure.

2) Develop a constant emergency warning system.

3) Maintain the program of annual technical inspections.

4) Implement and intensify a program of diligent and periodic maintenance including, but not limited to:

a) Backfilling animal burrows with suitable, well tamped soil.

b) Mowing brush on slopes.

c) Clearing accumulated debris from trash racks.

5) Consider the need for a safety barrier around the impact basin structure.

2.4 Alternatives

There are no meaningful alternatives to the above recommendations.

APPENDIX A

VISUAL INSPECTION CHECKLIST

INSPECTION TEAM ORGANIZATION

Date: May 14, 1979

Project: NH 00265
SOUHEGAN RIVER WATERSHED DAM NO. 33
Wilton, New Hampshire
NHWRB 254.34

Weather: Overcast, drizzle, cool

INSPECTION TEAM

Nicholas A. Campagna	Goldberg, Zoino, Dunnicliff & Assoc. (GZD)	Team Captain
William S. Zoino	GZD	Soils
M. Daniel Gordon	GZD	Soils
Jeffrey M. Hardin	GZD	Soils
Paul Rapha	Andrew Christo, Engineers, Inc., (ACE)	Structures
Carl Kaplan	ACE	Structures
Tom Gooch	Resource Analysis, Inc. (RAI)	Hydrology
Robert Fitzgerald	RAI	Hydrology

Owner's Representative Present:

Gary Kerr - New Hampshire Water Resources Board

CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
DAM EMBANKMENT		
Crest Elevation	AVG	698.2'
Current Pool Elevation		691.3'
Maximum Impoundment		No data
Surface Cracks		None
Pavement Condition		Not applicable
Movement or Settlement of Crest		None
Lateral Movement		None
Vertical Alignment		Good
Horizontal Alignment		Good
Condition at Abutment and at Concrete Structures		Good
Indications of Movement of Structural Items on Slopes		None
Trespassing on Slopes		4 to 6 animal burrows on left upstream slope
Sloughing or Erosion of Slopes of Abutments		None
Rock Slope Protection - Failures		No riprap - upstream slope good
Unusual Movement or Cracking at or Near Toes		None
Unusual Embankment or Downstream Seepage		None apparent
Piping or Boils	AVG	None

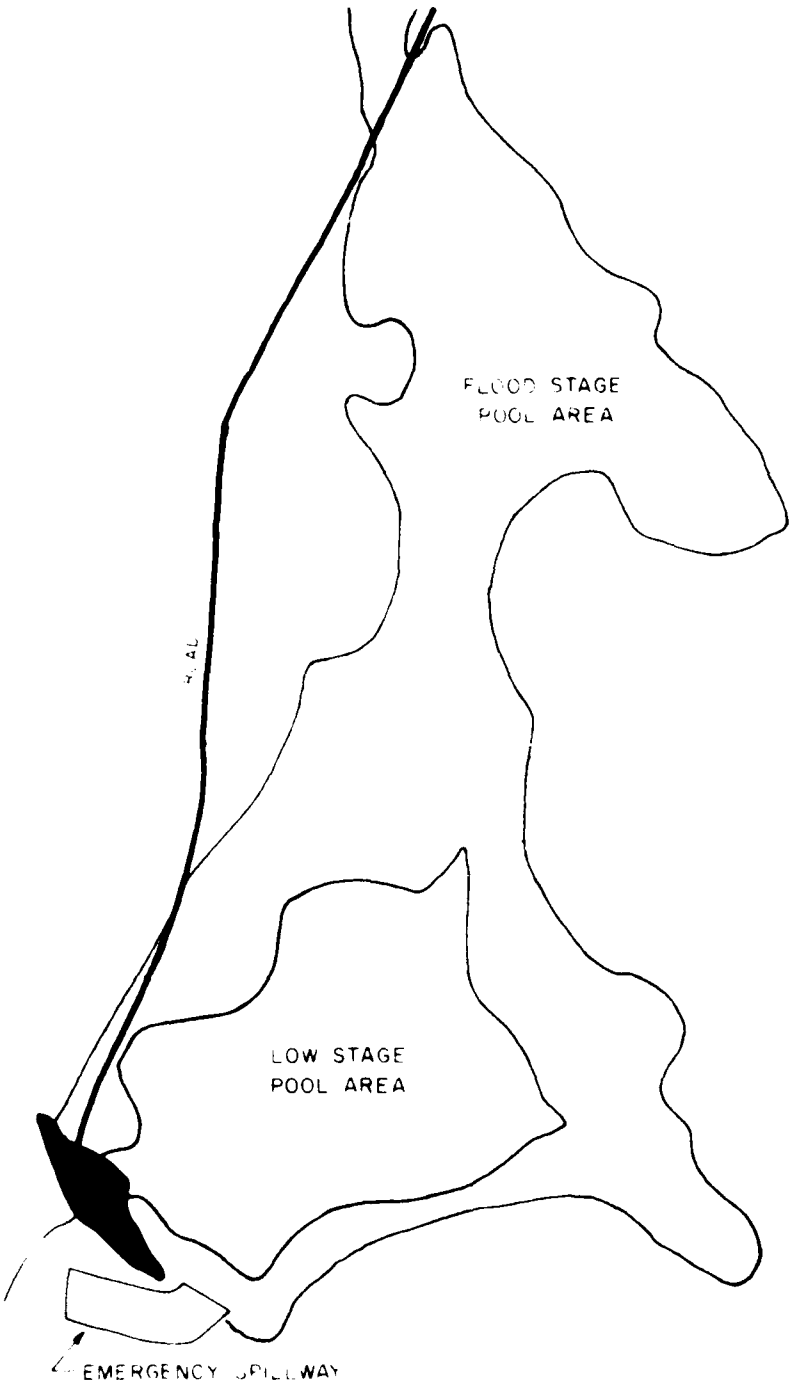
CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
Foundation Drainage Features		Drainage trench on emergency spillway added 2 years ago
Toe Drains		Toe drains submerged
Instrumentation System		None
APPURTENANT STRUCTURES		
A. Prop. Inlet Service Spillway Structure		
Condition of concrete		Good
Spalling		None noted
Erosion		None noted
Cracks		Minor at construction joints
Rust or staining on concrete		Minor staining at water line
Visible reinforcing		None noted
Efflorescence		None noted
Honeycombs		Minor at construction joints
Trash Racks		
Upper stage trash racks		No deficiencies noted
Lower stage trash racks		Staining of galvanized surfaces
Bench Stand		No deficiencies noted
B. Reservoir Discharge Conduit		Submerged, could not be observed

CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
C. Outlet Conduit (primary spillway	CC	No deficiencies noted
D. Impact Basin		
Condition of concrete		Good
Spalling		None noted
Erosion		Minor on headwall at water line
Cracking		None noted
Rusting or staining of concrete		Minor on headwall
Visible reinforcing		None noted
Differences	VC	Minor 6" x 2.7' at both ends of top of baffle wall

APPENDIX B



GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC GEOTECHNICAL CONSULTANTS NEWTON UPPER FALLS, MASS	U.S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS

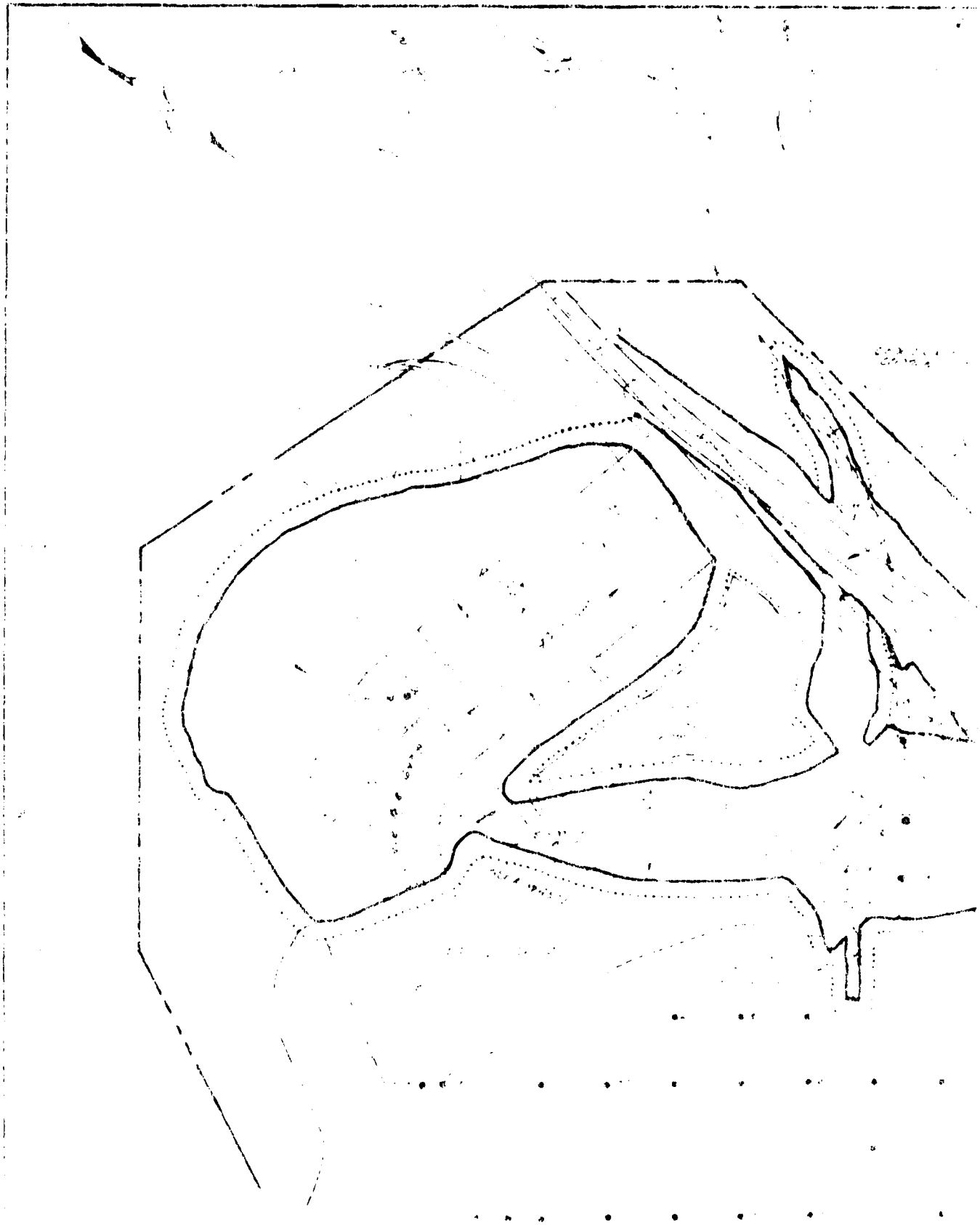
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

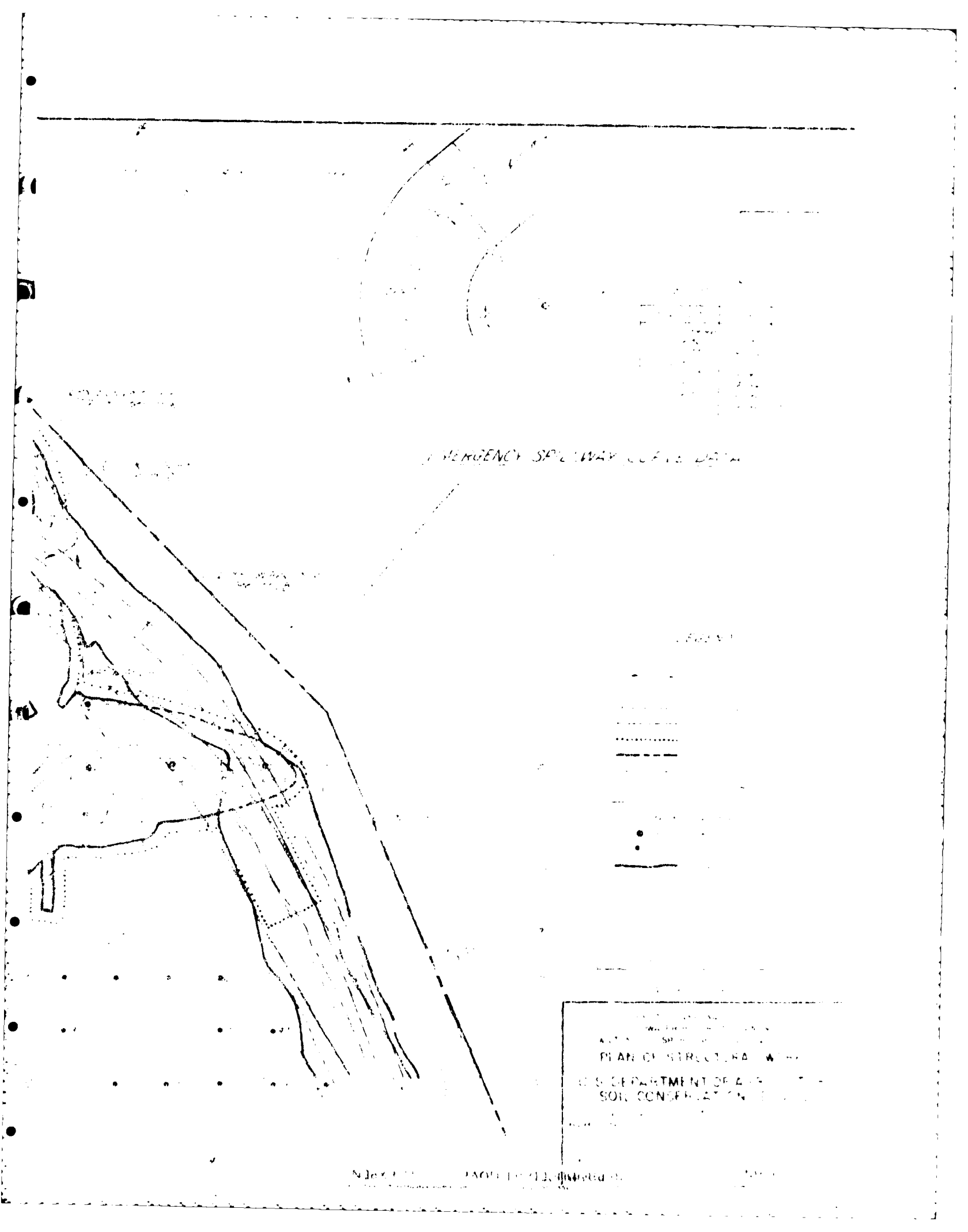
SITE PLAN

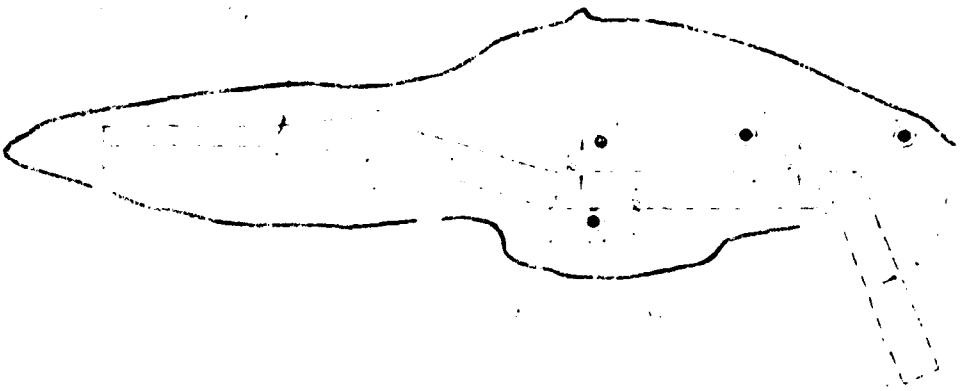
SOUHGAN RIVER WATERSHED
DAM No. 33

FILE No. 2327

SCALE 1" = 400'
DATE MAY 1979

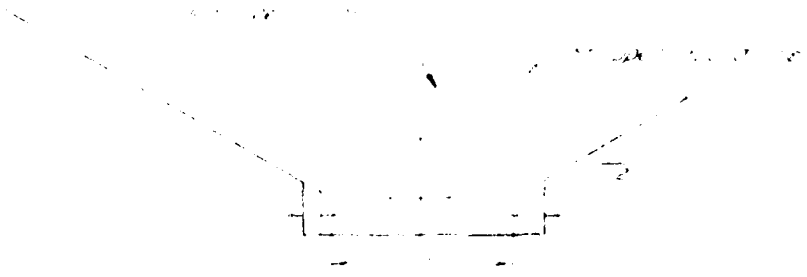






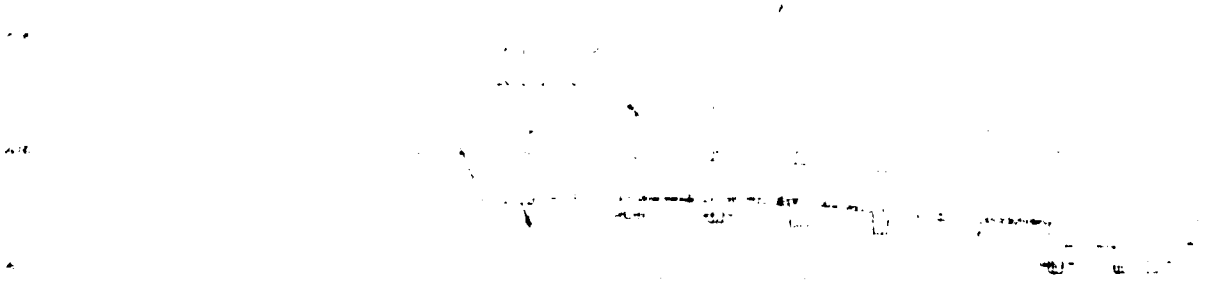
TYPICAL SECTIONS OF CUTOFF TRENCH

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



PRINCIPAL SPILLWAY EXCAVATION AT ANTI-SEEP COLLAR

FRONTAL COLLAR EXCAVATION

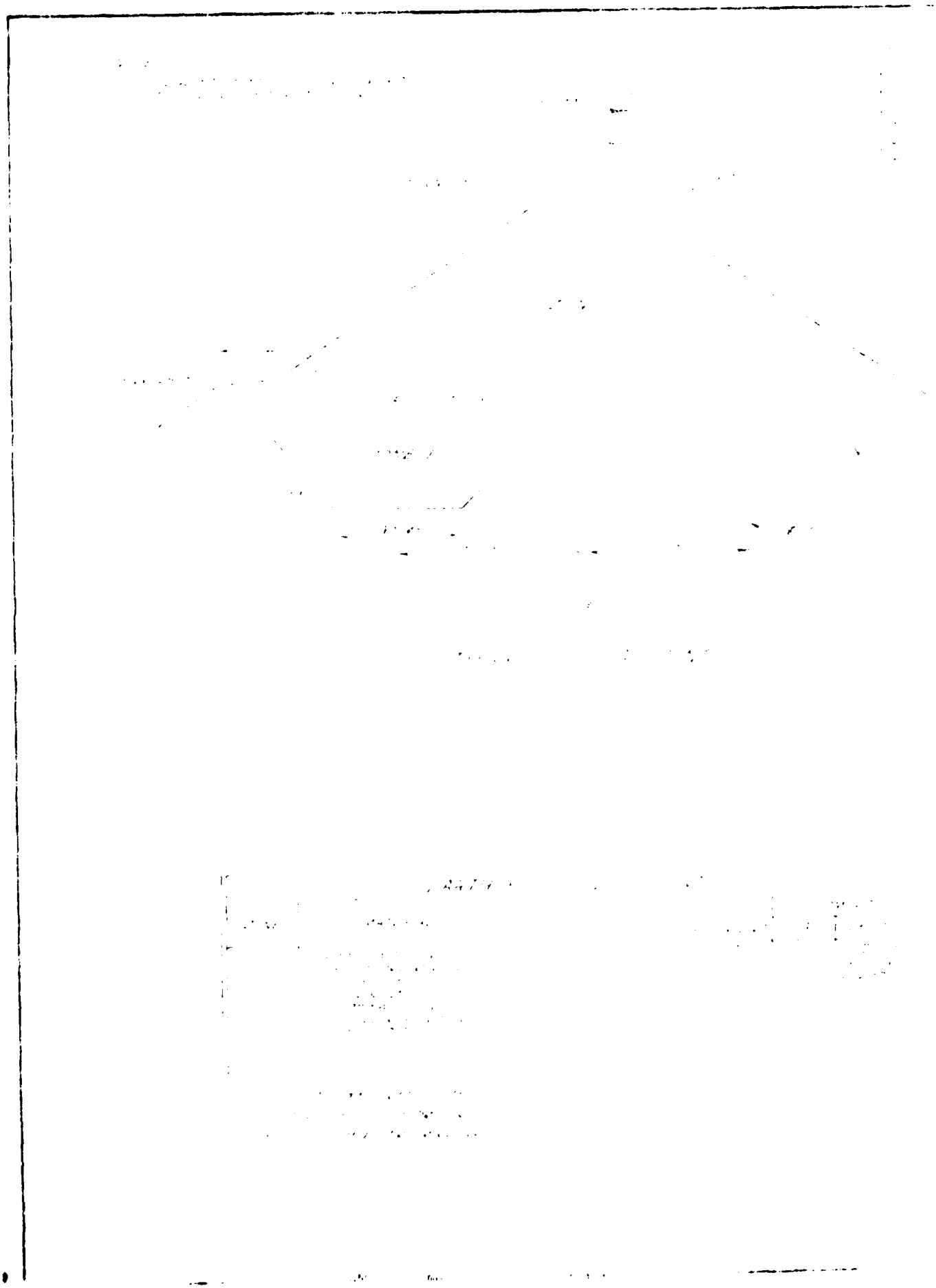


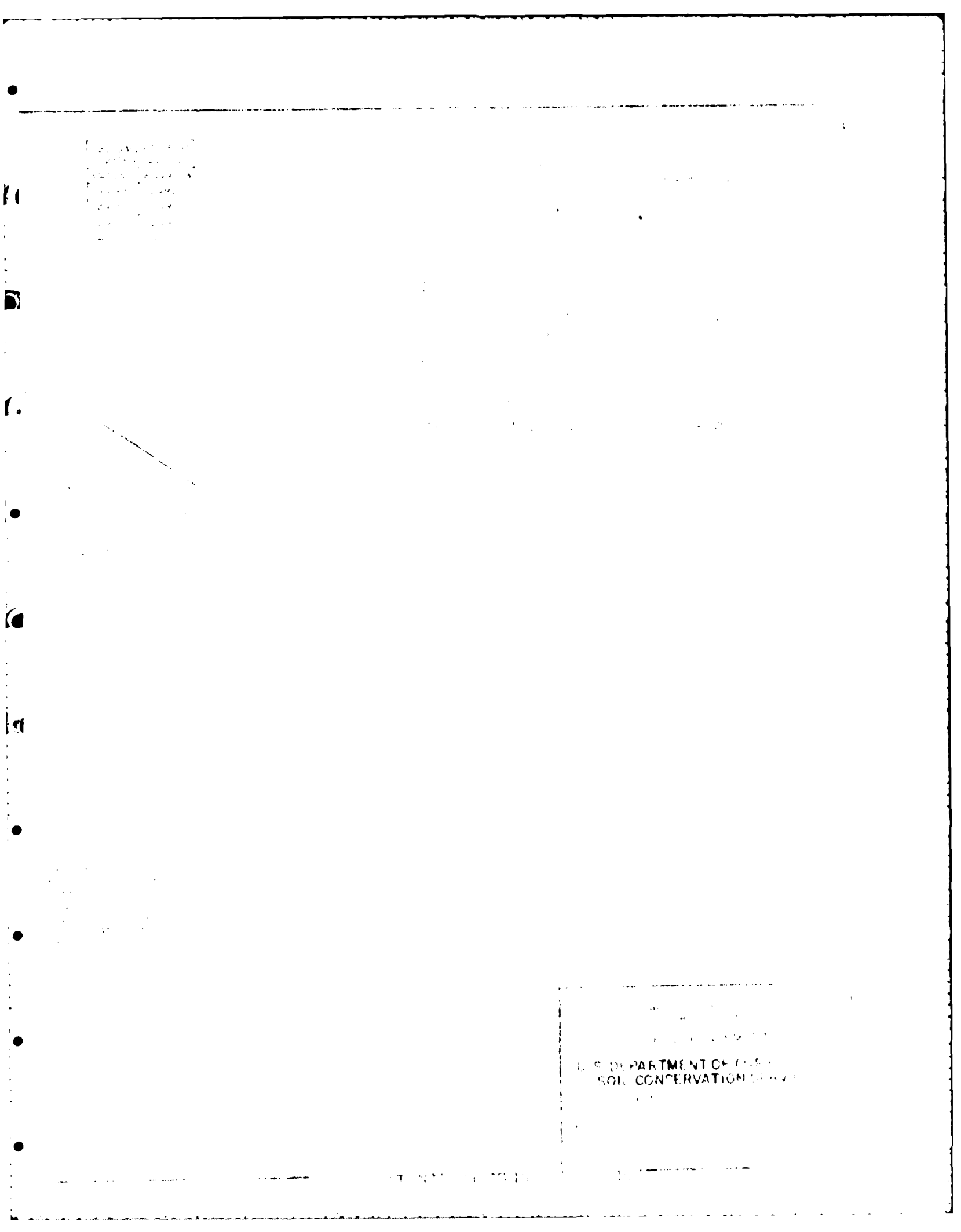
PROFILE ALONG CENTERLINE SPILLWAY

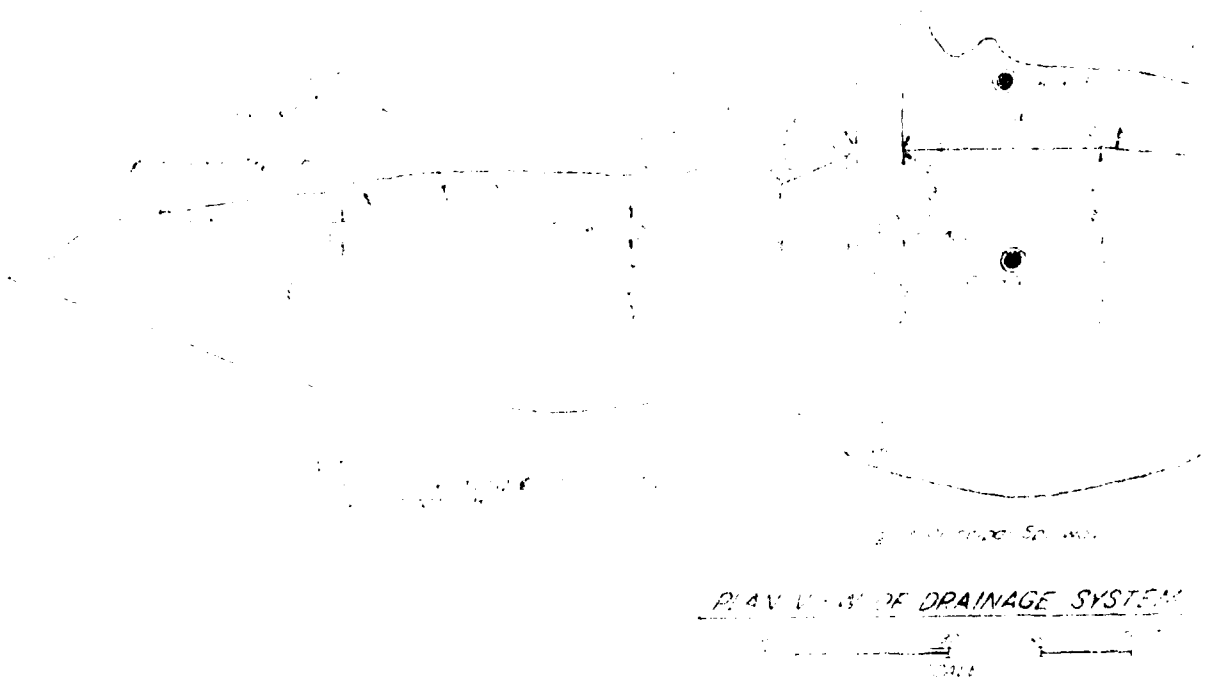
EMERGENCY SPILLWAY EXCAVATION

PROFILE ALONG C OF EMERGENCY SPILLWAY

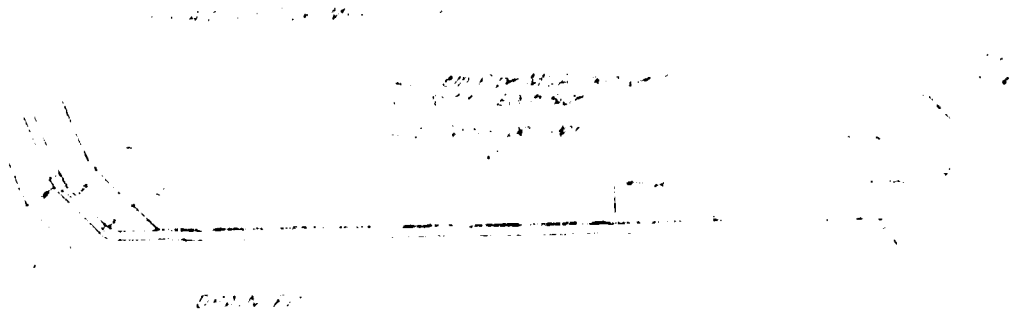
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

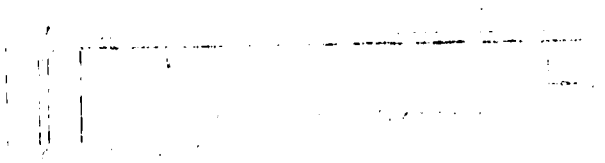




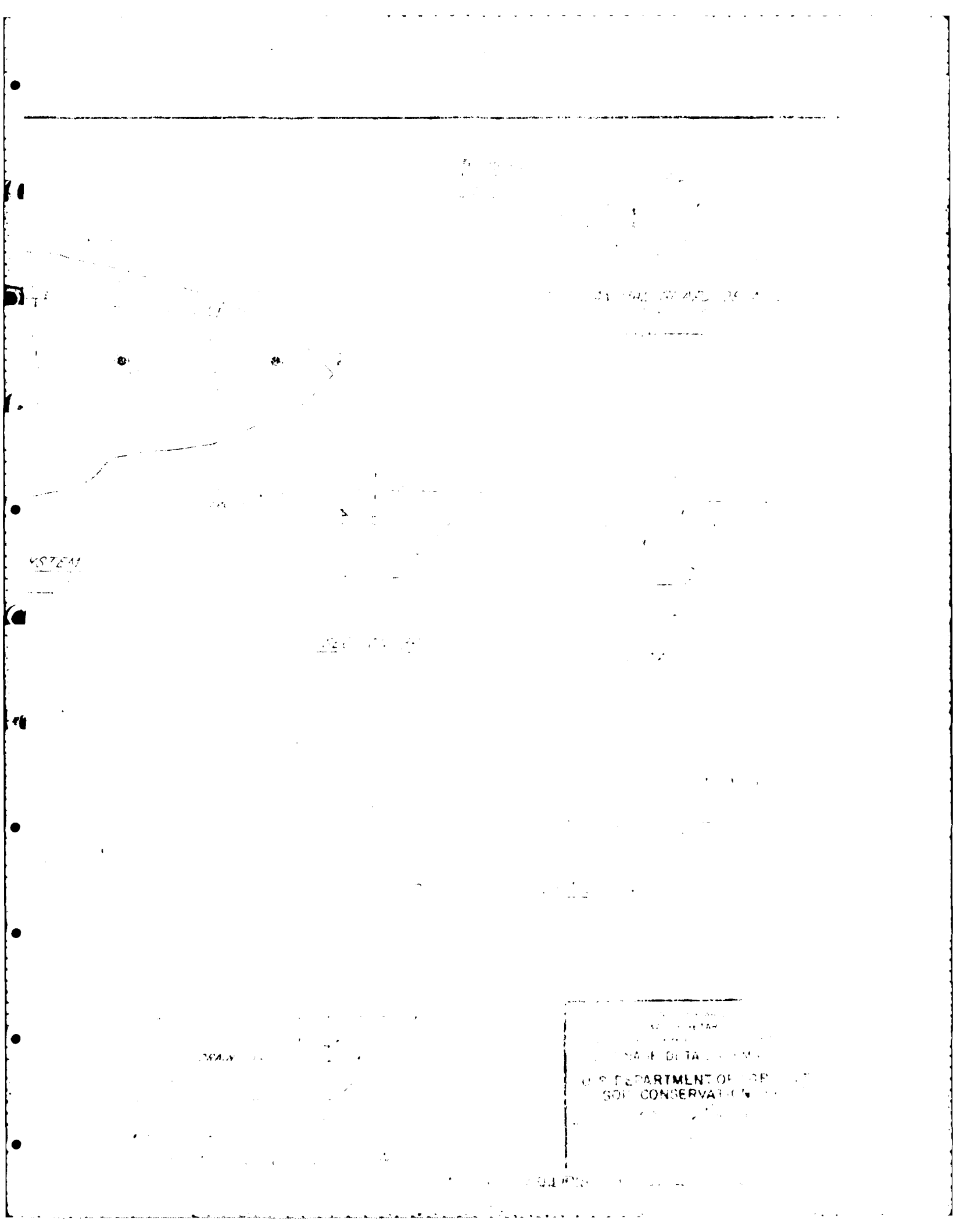


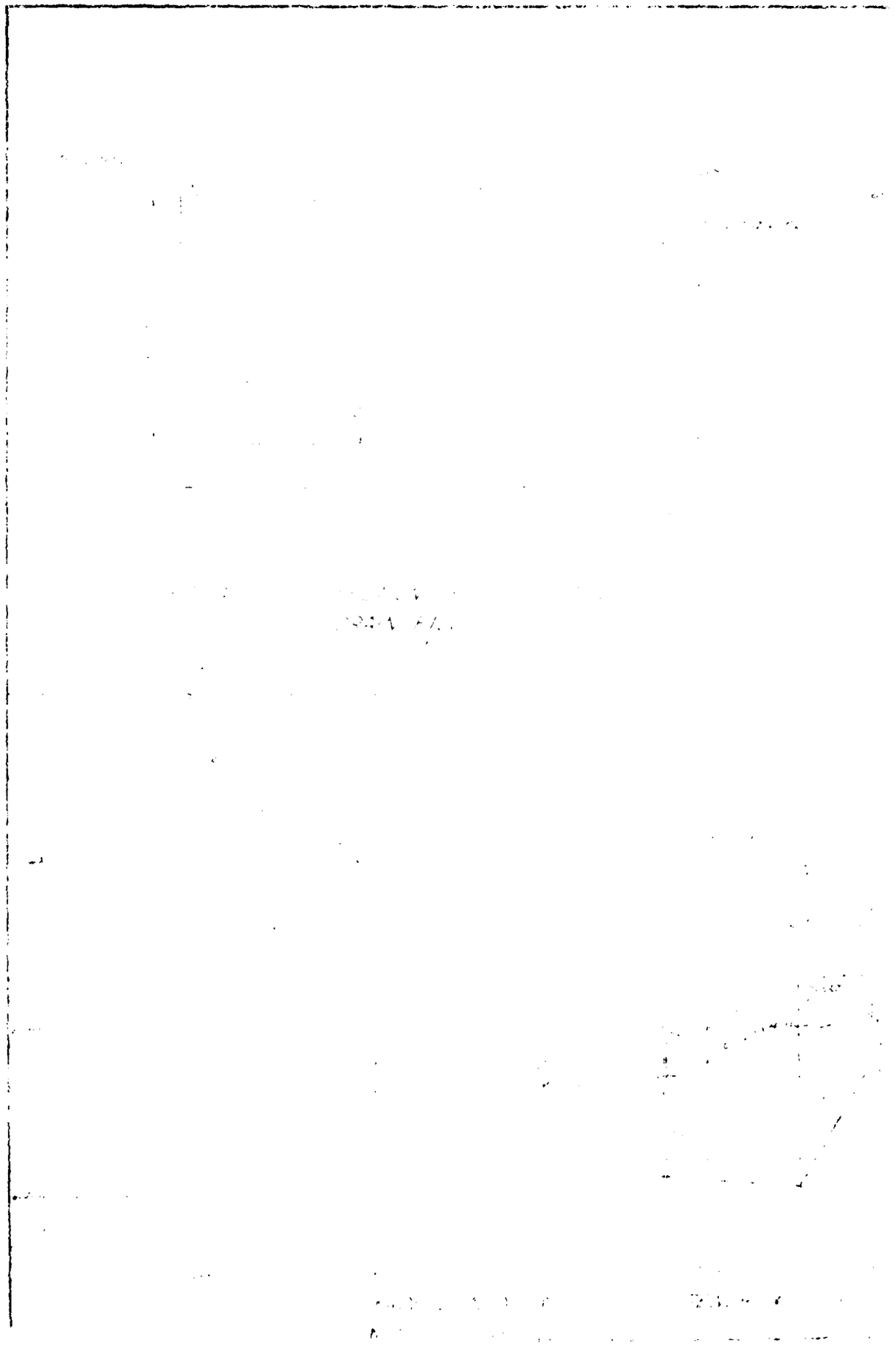
PLAN VIEW OF DRAINAGE SYSTEM

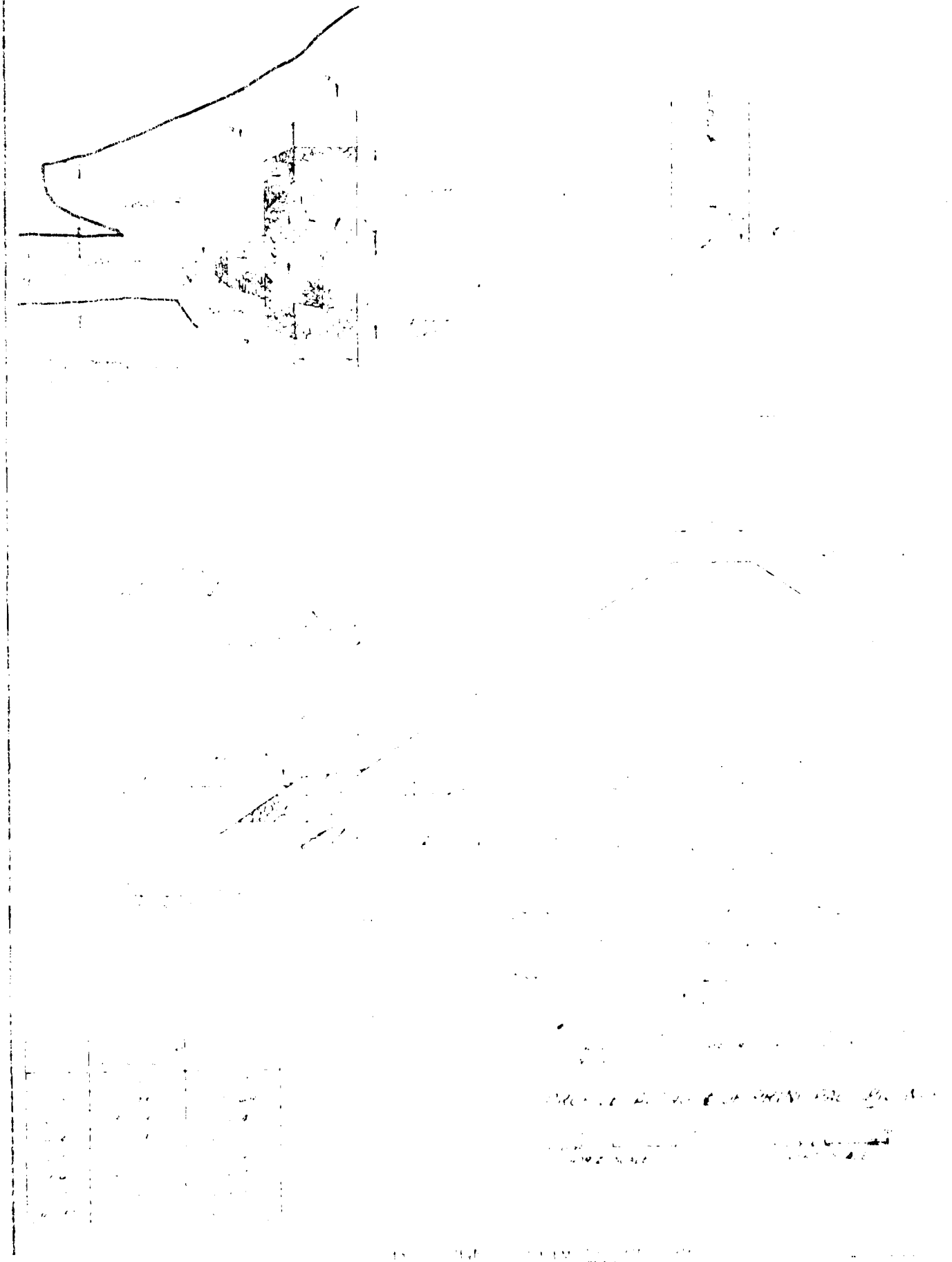


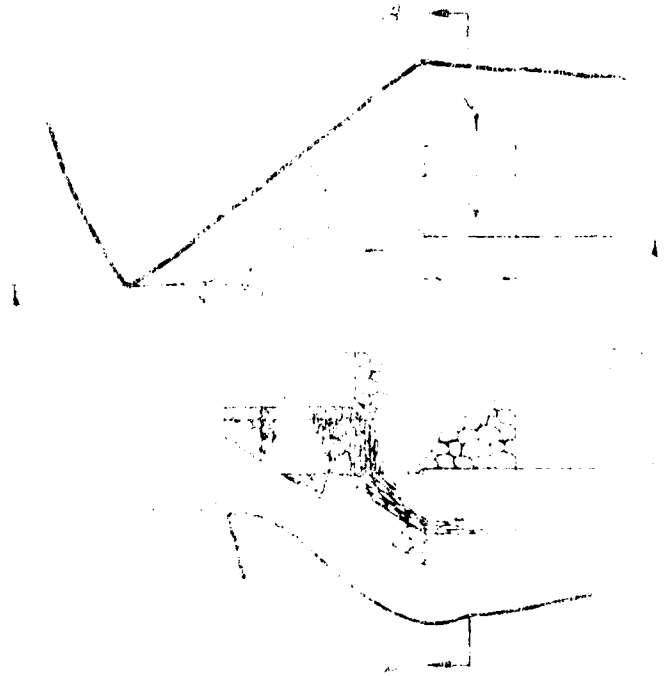


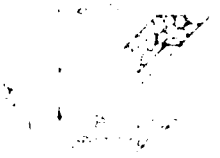
AN VIEW OF OUTL


U.S. DEPARTMENT OF
SOIL CONSERVATION









SECTION A-A

PRINCIPAL SPILLWAY

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TP-1 Sta. 1 + 36, R/L + 23, Elev. 696.4

0.0 – 8.0 SM - sand, silty with gravel, cobbles and boulders, 5% boulders (max. size 1.0 x 1.0 x 1.0), 10% cobbles (5% to 12"), 15% gravel, 70% sand, 25% fines, poorly graded, fine, yellow brown, dry, moderately permeable

8.0 – 7.0 SM - gravel, sandy with cobbles, boulders and silt, 5% boulders (max. size 1.0 x 1.0 x 1.0), 10% cobbles (5% to 12"), 35% gravel, 35% sand, 10% fines, poorly graded, fine, dry, yellow grey brown, moderately permeable (Glacial till)

7.0 Tested boulders

Test pit terminated at 7.0 feet due to boulders

Groundwater was encountered at 4.5 feet during excavation. Water was flowing from fractures at 4.5 feet and 5.0 feet. Water level at completion was 4.5 feet. Fractures were 1/8 inch wide, 0 fractures were encountered from 0.0 to 4.5 feet.

Sample No.	Depth (ft)	Soil Description	Remarks

Standing water level in test pit

Time	Depth	Remarks

Water level deeper than 7.0 feet 1/ 24

K at 4.5 feet = 1.2 x 10⁻² feet per day
K at 5.0 feet = 29.21 feet per day
K at 6.0 feet = pressure loss
K at 7.0 feet = 3.76 feet per day
K at 7.5 feet = pressure loss

1/ Ib. buried 4.5 feet on 7/8

TP-2 Station 1 + 70, 1.5 Rt, Elev. 70

0.0 – 8.0 Made-land (Fill)

8.0 – 12.0 SM - sand, silty - gravel, sandy, cobbly, gravel, 15% sand, 25% fines, poorly graded, sub-angular, grey and yellow brown, moist, dense, slight, permeable, very dense

Refusal at 12.0 feet on boulders

Standing water level

Time	Depth	Remarks

Water level deeper than 12.0 feet

K at 8.0 feet = 1.2 x 10⁻² feet per day
K at 9.0 feet = 0.56 feet per day
K at 10.0 feet = 1.22 feet per day
K at 11.0 feet = 4.9 feet per day

TP-3 Station 1 + 60, 65 Rt, Elev. 66

0.0 – 5.0 SM - sand, silty with gravel, cobbles and boulders with 5% boulders (max. size 1.0 x 1.0 x 1.0), 10% cobbles (5% to 12"), 20% gravel, 25% sand, 25% fines, poorly graded, fine, brown, a formerly permeable

5.0 – 7.0 SM - sand, silty with gravel, cobbles, and boulders (max. size 1.0 x 1.0 x 1.0), 10% cobbles (5% to 12"), 35% gravel, poorly graded, fine, brown, a glacial till

7.0 Tested boulders

Test pit terminated at 7.0 feet due to boulders

SM - silt, sandy with gravel, 5% boulders (max. size 1.0 x 1.0 x 1.0), 10% cobbles (5% to 12"), poorly graded, fine, brown, moist, dense, slight moisture, high dry strength, a glacial till

TP-4 Station 1 + 30, 65 Rt, Elev. 69

0.0 – 4.0 SM - sand, silty with gravel, 5% boulders (max. size 1.0 x 1.0 x 1.0), 5% cobbles (5" to 12"), 15% gravel, poorly graded, fine, brown, moist, dense, moderately permeable, formerly glacial till

4.0 – 7.0 SM - sand, silty with clay, gravel and cobbles, poorly graded, mottled brown grey, moist, slight moisture, slowly permeable, a glacial till

Test pit terminated at 7.0 feet

TP-5 Station 1 + 00, 65 Rt, Elev. 69

0.0 – 4.0 SM - sand, silty with gravel, 5% boulders (max. size 1.0 x 1.0 x 1.0), 10% cobbles (5" to 12"), 15% gravel, 60% sand, 10% fines, poorly graded, fine, brown, moist, dense, slight moisture, a glacial till

4.0 – 7.0 SM - sand, silty with clay, gravel and cobbles, poorly graded, mottled brown grey, moist, slight moisture, slowly permeable, a glacial till

Test pit terminated at 7.0 feet

MAINTENANCE CHECKLIST FOR PL 566 FLOOD CONTROL STRUCTURES

This maintenance checklist is a guide for determining the maintenance required for public law 566 flood control structures in New Hampshire. It doesn't take the place of experience and judgment and is not inclusive. Items of a difficult nature to check, such as principal spillway conduit condition, are not included. Intensive checks of these items are necessary at proper intervals. Review of as-built drawings, the design folder, structure history, and previous maintenance reports should be part of the inspection. Prompt maintenance is a vital part of safe and effective operation.

Except where otherwise indicated, completion of this form may be facilitated by ranking maintenance items on a 1 to 4 basis where

1 = satisfactory
2 = satisfactory, but check carefully at next inspection
3 = requires maintenance this season
4 = requires immediate attention.

DAM SIX

WATERSHED SOUHEGAN SITE 33 DATE 6-3-87

INSPECTED BY KARL MCCLEARY HUTCHINSON KINGSLEY MACPHERSON

1. GENERAL ITEMS

Access Road.	1
Site Fencing.	2
Traffic Conditions.	1
Vandalism Control.	1
Trash Control.	2

COMMENTS FENCE AT AT END OF DAM DOWN. TOP OF DAM & EMERGENCY SPILLWAY RUTTED BOTH OF THESE ITEMS SHOULD BE REPAIRED BY CONTRACTOR DURING REPAIR WORK. LOW STAGE TRASH RACK IS PLUGGED

2. RESERVOIR

Timber stand at reservoir.	2
Debris and slash.	2
Sediment level in relation to low stage inlet	

COMMENTS

5/77

SOIL CONSERVATION SERVICE
US DEPARTMENT OF AGRICULTURE

EMBANKMENT AND EXCAVATED SLOPES

(Report riprap and vegetation and erosion condition under Items 4 and 5.)

	Dam	Dike	Emergency Spillways 1/ left	Emergency Spillways 1/ right	Other (____)	Other (____)
Sliding or sloughing	1	—	1	—	—	—
Holes (rodent and other) (check especially at embankments)	1	—	1	—	—	—
Excessive settlement (embankments)	1	—	1	—	—	—
Cracks						
Traverse	1	—	1	—	—	—
Longitudinal	1	—	1	—	—	—
Seepage 2/	1	—	2	—	—	—
Piping 2/	1	—	1	—	—	—

COMMENTS RUTS ACROSS TOP OF DAM & IN EMERGENCY SPILLWAY RIER SHOULD BE REPAIRED.

RIPRAP

	Displ. of Rock	Loss of Spalls	Loss of Bedding	Erosion of Bound.	Breakdown of Rock
Dam					
Upstream berm	—	—	—	—	—
Principal Spillway Outlet	1	1	—	1	1
Embankment Gutters					
left	—	—	—	—	—
right	—	—	—	—	—
Emergency Spillway					
location_____	—	—	—	—	—
location_____	—	—	—	—	—
Waterways					
location_____	—	—	—	—	—
location_____	—	—	—	—	—
Outlet Channel	—	—	—	—	—
Other RD CULVERT	1	1	—	1	1

COMMENTS NEW WORK NOT EVALUATED BECAUSE WORK IS NOT COMPLETE.

1/Looking downstream.
2/Check especially at downstream face of embankments.

5. VEGETATION

	Dam	Emergency Spillways left	Emergency Spillways right 1/	Dike	Outlet Channel	Water way	Other (_____)
Condition of stand (including need for lime and fertilizer)	1	4	—	—	1	—	—
Undesirable vegetation	1	1	—	—	1*	—	—
Drainage (surface)	1	4	—	—	1	—	—
Erosion 2/	1	4	—	—	1	—	—
Sedimentation	NA	1	—	—	3	—	—
Condition of planting	NA	NA	—	—	NA	—	—
Pest control	—	—	—	—	—	—	—
Fire control	—	—	—	—	—	—	—

COMMENTS POOR VEGETATIVE COVER CONDITION OF EMERGENCY SPILLWAY IS IN PROCESS OF BEING CORRECTED. GOOD CROWN VETCH COVER ON DAM

* VEGETATION BETWEEN RD CULVERT & IMPACT BASIN IS RETARDING FLOW IN OUTLET CHANNEL

6. EMBANKMENT, STRUCTURAL, & OTHER DRAINS

		Dam left	Dam right 1/	Other (_____)	Other (_____)
Depth of Flow (in inches above invert)	With any obstruction	—	—	—	—
	Without any obstruction	—	—	—	—
Turbidity of Discharge (yes, no)	With any obstruction	—	—	—	—
	Without any obstruction	—	—	—	—
Condition of Protective Coating	Outside	—	—	—	—
	Inside	—	—	—	—
Obstruction in Flow (yes, no)		YES	YES	—	—
Animal Guard Condition		—	—	—	—
Outlet Condition		—	—	—	—

Retarding Pool Elevation (ft. msl)_____ or_____(ft.) above / below _____

Other_____

COMMENTS DRAINS PARTIALLY INUNDATED BY BACKWATER FROM GROWTH IN CHANNEL.

1/Looking downstream.
2/Including wave, surface, stream, manmade, and livestock erosion.

7. RISER

Caution Be extremely careful when using ladders. Check condition before using. Ladders are sometimes broken, loose, corroded, and or slippery.
Use safety harness.

Ladders: inside and out	Condition of protective coating___; Corrosion___; Damaged parts___; Loose___; Other___.
Concrete: inside and out	Cracking___; Spalling___; Other deterioration___; Excessive movement (check joint at riser and conduit)___; Other___.
Trashracks: low and high stage	Condition of protective coatings___; Corrosion___; Damaged parts___; Condition of fastenings___; Need of gratings due to beaver___; Safety condition (protruding fastenings, sharp edges, etc.)___; Other___.
Manhole:	Condition of protective coatings___; Corrosion___; Damage___; Lock operable___; Other___.
Gate: including lifting device, stem, guides, disc	Condition of protective coating___; Corrosion___; Damaged parts___; Condition of fastenings___; Stem alignment___; Lubrication___; Operation___; Other___.
Safety Items:	Condition of warning signs___; Condition of safety equipment___; Other___.

COMMENTS LOW STAGE APPEARS TO BE PLUGGED BY BEAVER DAM. WATER RESOURCES BOARD PERSONNEL WILL CHECK RISER & APPURTENANCES AT LATER DATE WHEN WATER RECEDES.

(specify)_____ _____

Concrete: inside and out	Cracking___; Spalling___; Other deterioration ___; Excessive movement (check joints)___; Waterstops___; Joint sealant___; Other___.
Trashracks: low and high stage	Condition of protective coatings___; Corrosion ___; Damaged parts___; Condition of fastenings___; Need of gratings due to beaver___; Safety condition (protruding fastenings, sharp edges, etc.)___; Other___.
Gates: including lifting device, stem, guides, disc, flap	Condition of protective coating___; Corrosion ___; Damaged parts___; Condition of fastenings___; Stem alignment___; Operation___; Lubrication___; Wood decay___; Other___.
Structure Drainage:	Report under "Embankment and Other Drains"
Structure, Railing, Grates, Barriers, etc.	Condition of protective coating___; Corrosion ___; Damaged parts___; Condition of fastenings___; Wood decay___; Safety condition (protruding fastenings, sharp edges, etc.) ____; Other___.
Safety Items:	Condition of warning signs___; Condition of safety equipment___; Other___.

COMMENTS_____

9. CHANNEL

Stream obstructions.	4
Debris in stream.	5
Sediment bars controlled.	3
Plunge pool stability.	1
Fish habitat appurtenances	—

Riprap -- Report under "Riprap" (item 4)

COMMENTS GRASS IN OUTLET CHANNEL RESTRICTING FLOW - DRAINS SUBMERGED

MAINTENANCE CHECKLIST FOR PL 566 FLOOD CONTROL STRUCTURES

This maintenance checklist is a guide for determining the maintenance required for Public Law 566 flood control structures in New Hampshire. It doesn't take the place of experience and judgment and is not inclusive. Items of a difficult nature to check, such as principal spillway conduit condition, are not included. Intensive checks of these items are necessary at proper intervals. Review of As Built drawings, the design folder, structure history, and previous maintenance reports should be part of the inspection. Prompt maintenance is a vital part of safe and effective operation.

Except where otherwise indicated, completion of this form may be facilitated by ranking maintenance items on a 1 to 4 basis where

1 = satisfactory
2 = satisfactory, but check carefully at next inspection
3 = requires maintenance this season
4 = requires immediate attention.

WATERSHED Salmon River SITE 33 25-32 DATE 6-15-78

INSPECTED BY Porter, Hutchinson, MacPherson, Kerr, Fife

1. GENERAL ITEMS

Access Road.	NA
Site Fencing.	3
Traffic Conditions.	2
Vandalism Control.	2
Trash Control.	3

COMMENTS Some trash on upstream face of dam. Some trash still lodged in low stage orifice.

2. RESERVOIR

Timber stand at reservoir.	2
Debris and slash.	2
Sediment level in relation to low stage inlet	2

COMMENTS

EMBANKMENT AND EXCAVATED SLOPES

(Report riprap and vegetation and erosion condition under Items 4 and 5.)

	Dam	Dike	Emergency Spillways left	Emergency Spillways right 1/	Other (____)	Other (____)
Sliding or sloughing	2	—	—	2	—	—
Holes (rodent and other) (check especially at embankments)	2	—	—	2	—	—
Excessive settlement (embankments)	2	—	—	2	—	—
Cracks						
Traverse	2	—	—	2	—	—
Longitudinal	2	—	—	2	—	—
Seepage 2/	2	—	—	2	—	—
Piping 2/	2	—	—	2	—	—

COMMENTS _____

4. RIPRAP

	Displ. of Rock	Loss of Spalls	Loss of Bedding	Erosion of Found.	Breakdown of Rock
Dam					
Upstream berm	—	—	—	—	—
Principal Spillway Outlet	—	—	—	—	—
Embankment Gutters					
left	—	—	—	—	—
right	—	—	—	—	—
Emergency Spillway					
location across outlet	2	2	2	2	2
location _____	—	—	—	—	—
Waterways					
location E.S. outlet	2	2	2	2	2
location _____	—	—	—	—	—
Outlet Channel	4	4	4	4	4
Other _____	—	—	—	—	—

COMMENTS Channel plugged with vegetation which results in high tailwater - can't see all of riprap. Impact basin drains also inundated because of tailwater.

5. VEGETATION

	Dam	Emergency Spillways left	Emergency Spillways right 1/	Dike	Outlet Channel	Water way	Other (_____)
Condition of stand (including need for lime and fertilizer)	1	2			1	1	
Undesirable vegetation	2*	1			4	1	
Drainage (surface)	1	1			1	1	
Erosion 2/	1	1			1	1	
Sedimentation	1	1			1	1	
Condition of planting	1	2			1	1	
Pest control	1	1			1	1	
Fire control	1	1			1	1	

COMMENTS Emergency spillway looks good so far. Fair population of trefoil, but leave alone for the present. Consider treatment another year.

Remove weed that block channel.

*Some weeds, but crown vetch will probably crowd out.

6. EMBANKMENT, STRUCTURAL, & OTHER DRAINS

		Dam left	Dam right 1/	Other (_____)	Other (_____)
Depth of Flow (in inches above invert)	With any obstruction	4	4		
	Without any obstruction	-	4		
Turbidity of Discharge (yes, no)	With any obstruction	4	4		
	Without any obstruction	4	4		
Condition of Protective Coating	Outside	4	4		
	Inside	4	4		
Obstruction in Flow (yes, no)		4	4		
Animal Guard Condition		4	4		
Outlet Condition		4	4		

Retarding Pool Elevation (ft. msl)_____ or_____(ft.) above / below

Other_____

COMMENTS Can't see drains. Vegetation in channel has caused water to back up and inundate drains.

1/Looking downstream.

2/Gullies, sheet, stream, roadside, and livestock erosion.

RISER

Caution Be extremely careful when using ladders. Check condition before using. Ladders are sometimes broken, loose, corroded, and or slippery.
Use safety harness.

Ladders: inside and out	Condition of protective coating___; Corrosion___; Damaged parts___; Loose___; Other___.
Concrete: inside and out	Cracking 1 ; Spalling 1 ; Other deterioration 1 ; Excessive movement (check joint at riser and conduit)___; Other___.
Trashracks: low and high stage	Condition of protective coatings 2 ; Corrosion 2 ; Damaged parts 1 ; Condition of fastenings 1 ; Need of gratings due to beaver 4 ; Safety condition (protruding fastenings, sharp edges, etc.)___; Other___.
Manhole:	Condition of protective coatings 2 ; Corrosion 2 ; Damage 2; Lock operable 2; Other 2.
Gate: including lifting device, stem, guides, disc	Condition of protective coating___; Corrosion___; Damaged parts___; Condition of fastenings___; Stem alignment___; Lubrication 2 ; Operation___; Other___.
Safety Items:	Condition of warning signs___; Condition of safety equipment___; Other___.

COMMENTS NHJEB will check gate. No ladder available. L.S. trash rack rusted.

IMPACT BASIN, SAF, BOX INLET, & MISCELLANEOUS CONCRETE STRUCTURES

(specify)_____ _____

Concrete: inside and out	Cracking 1 ; Spalling 1 ; Other deterioration 1 ; Excessive movement (check joints) 1; Waterstops 1 ; Joint sealant 1 ; Other___.
Trashracks: low and high stage	Condition of protective coatings___; Corrosion ___; Damaged parts___; Condition of fastenings___; Need of gratings due to beaver___; Safety condition (protruding fastenings, sharp edges, etc.)___; Other___.
Gates: including lifting device, stem, guides, disc, flap	Condition of protective coating___; Corrosion ___; Damaged parts___; Condition of fastenings___; Stem alignment___; Operation___; Lubrication___; Wood decay___; Other___.
Structure Drainage:	Report under "Embankment and Other Drains"
Structure, Railing, Grates, barriers, etc.	Condition of protective coating___; Corrosion ___; Damaged parts___; Condition of fastenings___; Wood decay___; Safety condition (protruding fastenings, sharp edges, etc.) ___; Other___.
Safety Items:	Condition of warning signs___; Condition of safety equipment___; Other___.

COMMENTS_____

9. CHANNEL

Stream obstructions.	4
Debris in stream.	4
Sediment bars controlled.	4
Plunge pool stability.	1
Fish habitat appurtenances	___
Riprap -- Report under "Riprap" (item 4)	

COMMENTS Undesirable vegetation in channel.

The U.S.D.A. Soil Conservation Service (SCS) located in Durham, New Hampshire, maintains a file for this dam. Included in this file are:

1) SCS "Hydrology and Hydraulics" design calculations dated 1968.

2) SCS structural design calculations dated 1971.

3) SCS "Detailed Geological Investigation of Dam Sites" dated 1965.

4) SCS soil mechanics laboratory data sheets dated 1966.

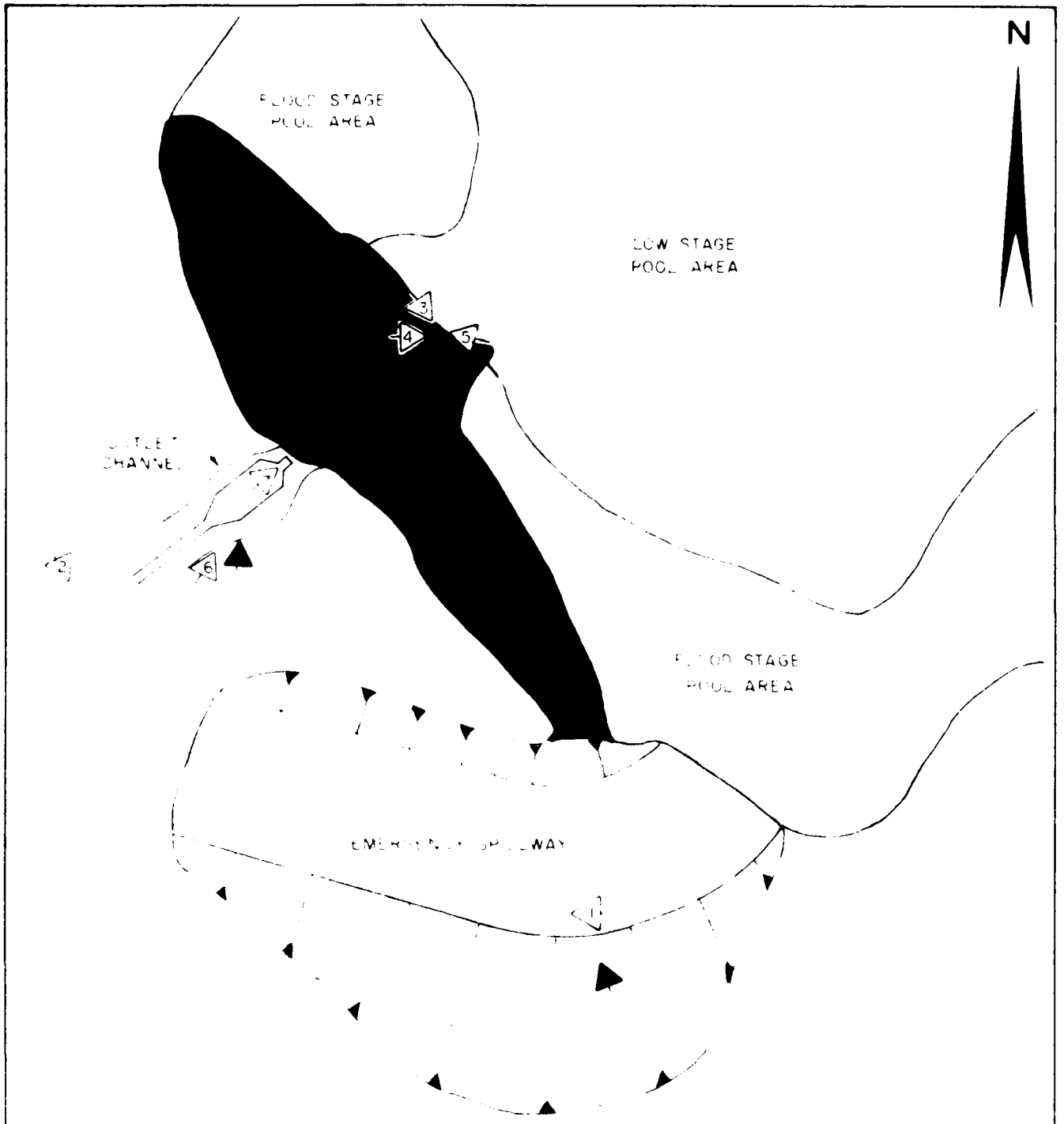
5) SCS "As Built" drawings dated October, 1973.

The New Hampshire Water Resources Board (NHWRB) maintains a correspondence file on this dam. Included in this file are:

1) Maintenance inspection checklists dated June 2, 1977 and June 15, 1978.

APPENDIX C

PHOTOGRAPHS



GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

LOCATION AND ORIENTATION OF PHOTOS

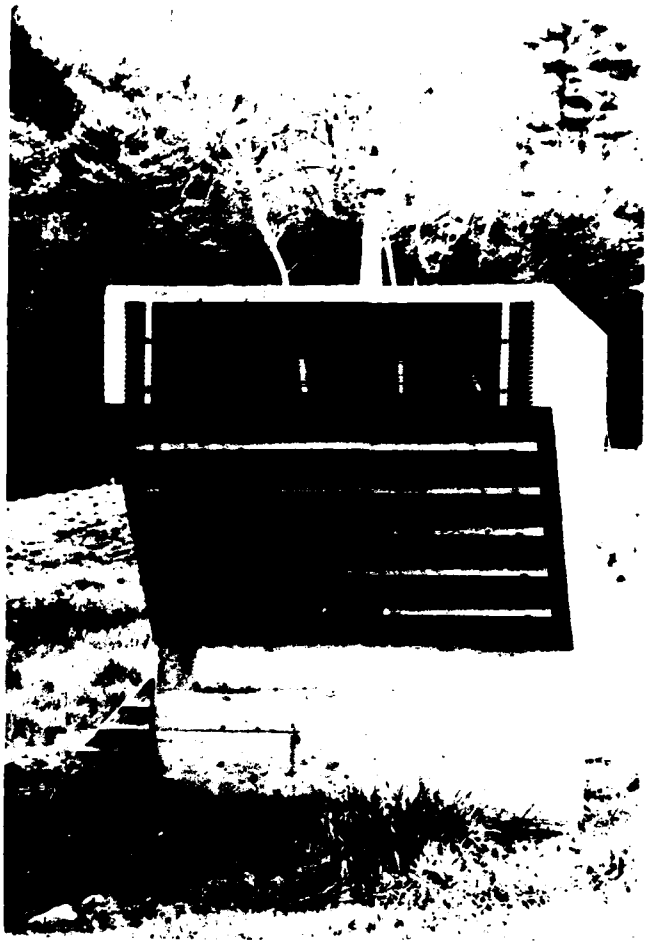
SOUHEGAN RIVER WATERSHED
DAM No 33

FILE NO.

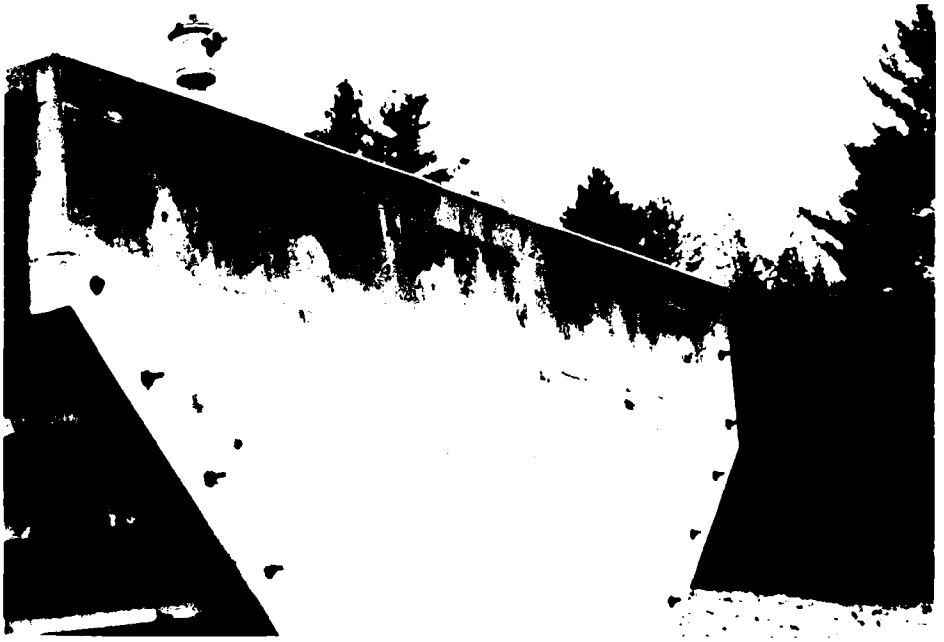
			SCALE
			DATE MAY 1974

1. View of emergency spillway showing ponded water

2. View of downstream end of emergency spillway showing drainage protection



3. View of right side of drop inlet structure



4. View showing joint erosion on drop inlet structure

5. View of drop inlet structure showing debris in low stage trash rack

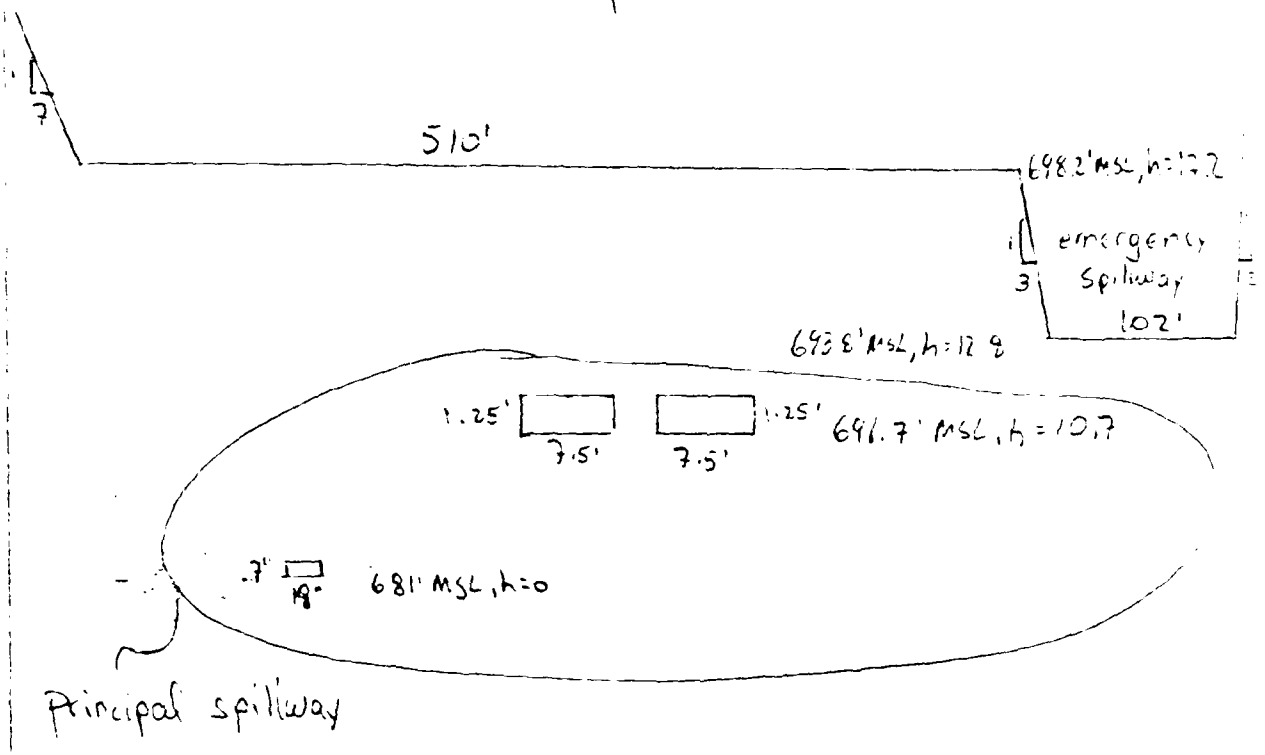
6. View of impact basin

7. View of downstream end of outlet pipe showing deterioration from cavitation

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

The information used to establish this elevation of Southegan River Watershed Dam # 33 was determined from field notes and S.C.S. construction plans dated 1971.



The 7"x18" orifice and the two 1.25'x7.5' orifices are on a riser structure in the reservoir. The flows from these outlets combine in the riser and flow under the dam through a 30" reinforced concrete pipe with its upstream invert at 676.5 ft MSL, and downstream at 674.5' MSL. The pipe is 114.9 ft long. At high flows the pipe controls the total outflow from the riser, which is called "principal spillway" outflow.

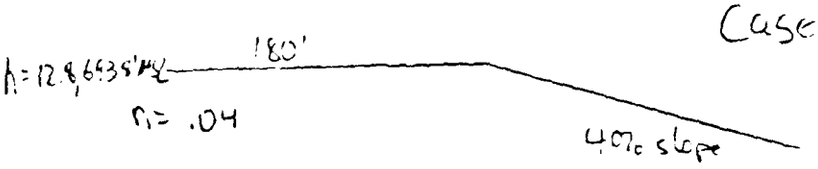
There is also a reservoir drain inlet which flows into the riser. The inlet is about 50' of 12" C.I.P. with its invert at 678 ft MSL. This inlet is not generally open, and will be

The SCS developed a Stage-Discharge Curve for the principal spillway (p. 27 of 'Hydrology & Hydraulics' Design calculations

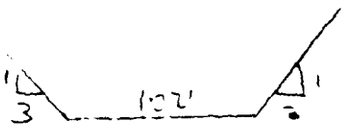
h	elevation	Low Stage orifice Flow (cfs)	High stage orifice Flow (cfs)	PIPE FLOW (cfs) (= principal spillway flow)
0	681	0		0
.5	681.5	1.6		1.6
1	682	3.5		3.5
2	683	5.5		5.5
4	685	8.1		8.1
6	687	10.0		10.0
9	690	12.5		12.5
10.7	691.7	13.6		13.6
11.2	692.2	13.9	16.3	30.2
12	693	14.4	69.0	83.4
12.5	693.5			86.0
12.9	693.8			87.3
13	694			88.0
13.5	694.5	pipe controls		89.4
14	695			90.7
14.5	695.5			92.0
15	696			93.5
15.5	696.5			94.7
16	697			96.1
16.5	697.5			97.5

The SCS also calculated the Stage-Discharge relationship for the emergency spillway assuming a crest width of 120 ft. The final design crest width is 102 ft, so we will redo the calculation. The profile of the spillway section is as follows,

Case I profile



cross-section:



Technical Release No. 39 of the SCS (May, 1968) gives a methodology for establishing H_p (Head in pool) vs. Q (emergency spillway). for our spillway:

CASE I profile
L = length of level section = 180'
n = manning's n = .04
z = sideslope = 3
b = width (bottom) = 102'

The table on p.4 established Q (em. spillway) using the methodology of SCS TR #39. The SCS calculates H_{ec}, the head at the emergency spillway crest after friction losses in the channel, and uses it to establish Q.

h (head above low flow outlet, ft)	elevation (ft msl)	H_p (head in pool, ft above spillway crest)	H_{ec} * (head at spillway crest, ft)	Q ** (cfs)
12.8	693.8	0	0	0
13	694	.2	—	~10 in bss
13.5	694.5	.7	~.30	52
14	695	1.2	.67	172
14.5	695.5	1.7	1.07	360
15	696	2.2	1.49	590
15.5	696.5	2.7	1.93	870
16	697	3.2	2.38	1170
16.5	697.5	3.7	2.83	1570
17.2	698.2	4.2	3.30	2000

* based on ES-171, p.1, for case I spillway w/ L=180', b=100', n=.04, z=2. Z & b differences are insignificant (< 1% in results)

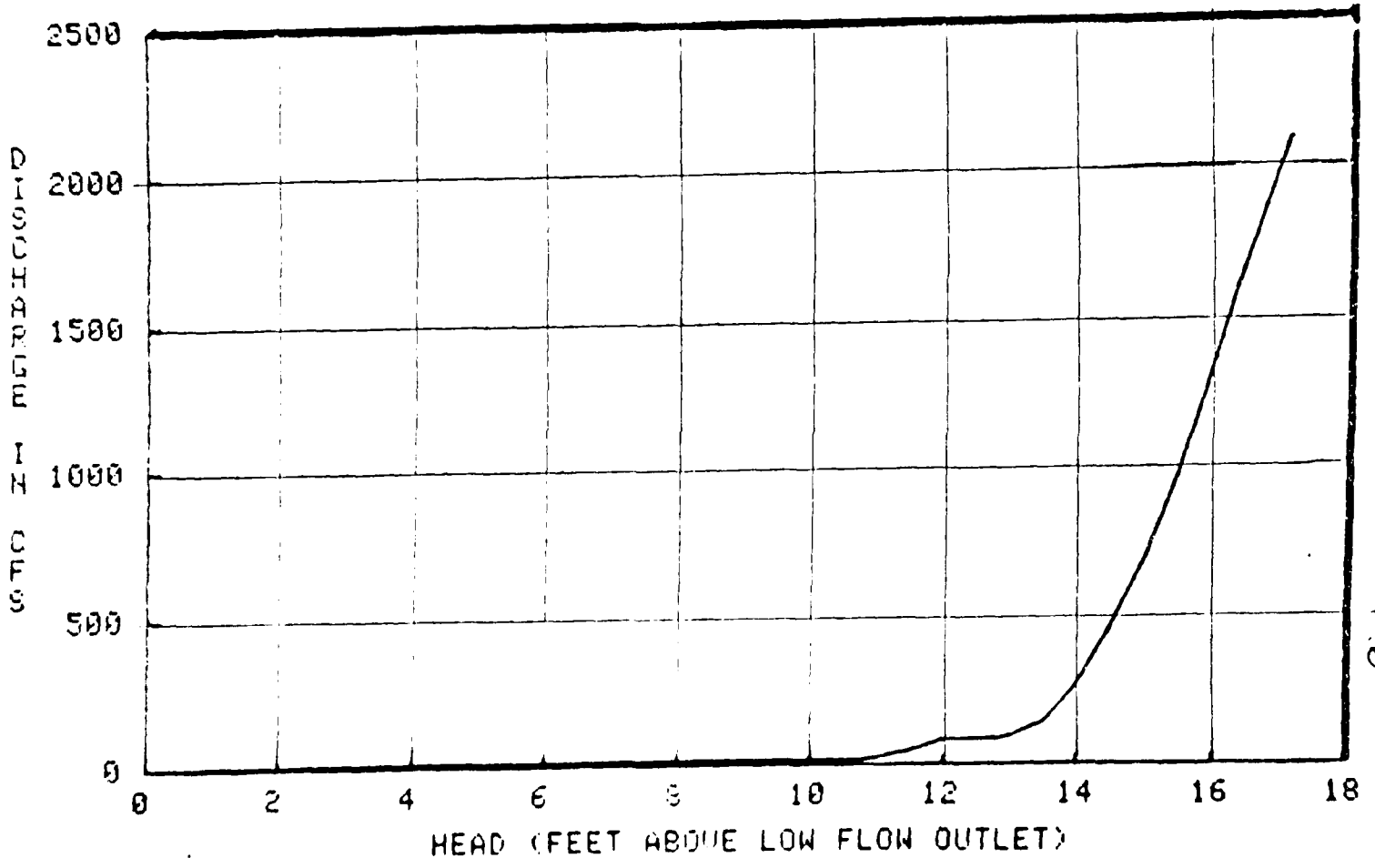
** Q vs. H_{ec}, ES-175, sheets 3 & 4, z=3, b=100

193 Dam Safety Evaluation Dam #33 TCG, 6/23/26, 12.5

Stage Vs. Discharge, SRWD #33. This relationship is plotted on P.C.

h (head above Low flow outlet, ft)	elevation (ft MSL)	Principal Spillway Discharge (cfs) (p.2)	Emergency Spillway Discharge (cfs) (p.4)	Total Discharge (cfs)
0	681	0	0	0
.5	681.5	1.6	0	1.6
1	682	3.5	0	3.5
2	683	5.5	0	5.5
4	685	8.1	0	8.1
6	687	10.0	0	10
9	690	12.5	0	12.5
10.7	691.7	13.6	0	13.6
11.2	692.2	30.2	0	30.2
12.	693.0	83.4	0	83.4
12.8	693.8	87.3	0	87.3
13	694	88	~10	98
13.5	694.5	89.4	52	141
14	695	90.7	172	263
14.5	695.5	92	360	452
15	696	93.5	590	684
15.5	696.5	94.7	870	965
16	697	96.1	1210	1310
16.5	697.5	97.5	1570	1670
17.2	698.2	99.2	2000	2100

STAGE-DISCHARGE CURVE AT SOUHEGAN R. W. DAM # 33



Storage-Elevation Curve

The following Storage-Elevation curve was taken from SCS "Hydrology and Hydraulics" calculations, p. 9, dated 1967.

h (storage above low flow outlet, ft)	elevation (ft. MSL)	Current Storage (Ac-Ft)	Available Storage (After 50 years) (Ac-Ft)
0	681	24	0
1	682	36.7	12.2
3	684	68.7	43.7
5	686	106	80.4
7	688	151	125
9	690	210	183
11	692	311	284
13	694	467	440
15	696	660	632
17	698	877	849
17.2	698.2	900	873

The storage-elevation curve is given on p. 8

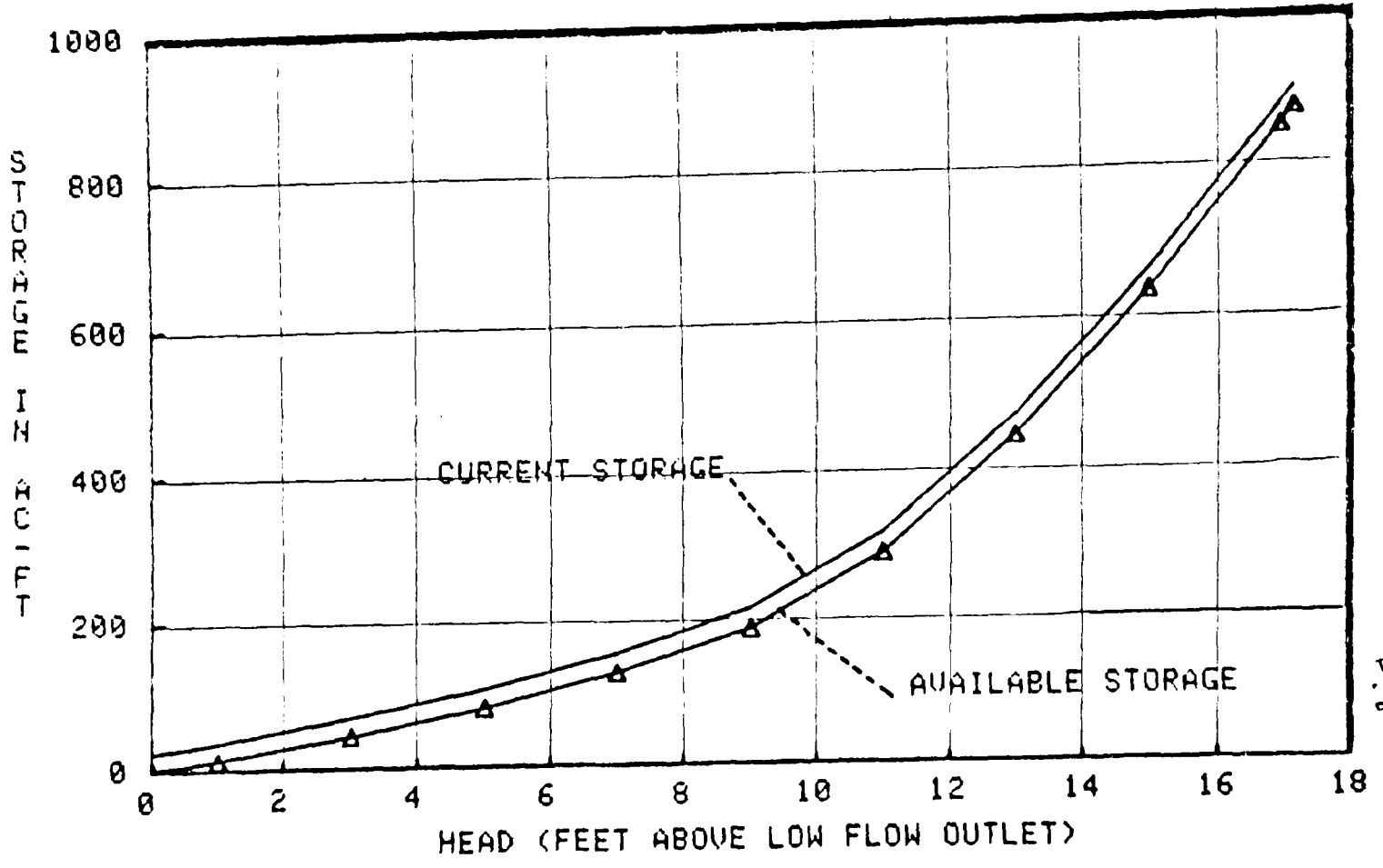
For 640 acres, 1" of runoff = $\frac{640}{12}$ = 53.3 ac-ft

1 Ac ft = $\frac{1}{53.3}$ = .01875" of rain

Current storage to Em. s/w crest = 450(.01875) = 8.5" of runoff

Current Storage to top of dam = 900(.01875) = 16.9" of runoff

STORAGE-ELEVATION CURVE FOR SOUHEGAN R. W. DAM # 33



D.S.

Dam Failure Analysis

Pp. D-25 is a Location and downstream hazard maps for S.R.W.D. # 33.

The first question to be addressed in the Dam Failure Analysis is the assumed water surface elevation at Dam failure. The normal assumption is that failure occurs with the water surface at the top of the dam. This would yield a pre-failure outflow of 2100 cfs, which would cause noticable flooding downstream (especially in Wilton) prior to dam failure. This flow is also greater than the routed PMF outflow at the dam. Dam failure would have a greater incremental impact on flooding if it were to occur with a lower water surface elevation in the reservoir. Therefore, for this analysis failure is assumed to occur with the water surface at SCS Design High Water, 695.4 ft. MSL, h=14.4 ft, 2.8 ft. below the dam crest. This represents 1.6 ft. of flow in the Emergency Spillway, and a pre-failure outflow of 414 cfs. Current storage at this elevation is 602 ac-ft.

Peak failure outflow = Normal outflow + Breach outflow

Normal outflow = 414 cfs

Breach outflow = $Q_{p_1} = 8/27 \sqrt{g}\, W_b\, y_0^{3/2}$

where: W_b = breach width = 40% of dam width at 1/2 height of dam = .4(205) = 82 ft. (width from Sheet 8 of SCS plans)

y_0 = height above tailwater at time of failure. Tailwater at S.R.W.D. #33 is erratic, controlled by Dale Street, with ft.

crosses the brook on which SRWD #33 is located about 100 ft. downstream of the principal spillway outlet. The brook passes under the road through a 30" culvert, and the road surface elevation is about 681.5 ft. Assumed tailwater = 682 ft MSL (½ ft over the road top).

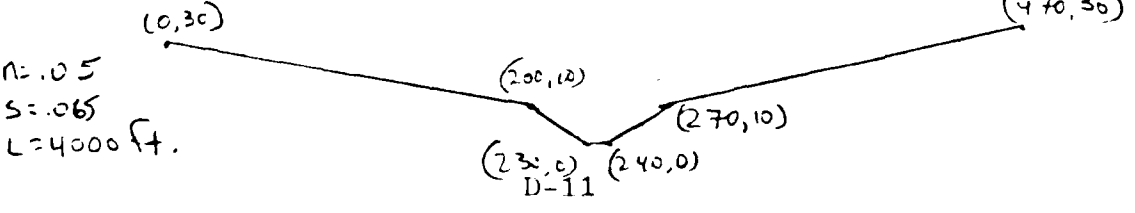
$Y_o = 695.4 - 682 = 13.4$ ft

$Q_{p_1} = 8/27 \sqrt{g}\ 82\ (13.4)^{3/2} = 6763$ cfs

failure outflow = 4144 + 6763 = 7180 cfs.

This failure flow would severely overtop and probably damage or destroy Dale St., which is a secondary paved road.

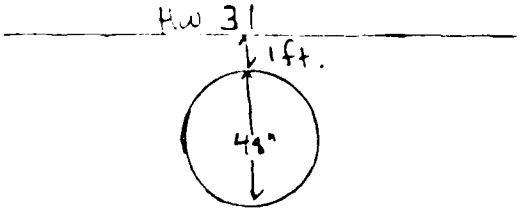
Below Dale St., the brook runs about 4000 ft. to feed into Stony Brook. The primary development in this reach is New Hampshire Highway 31, which crosses the brook just before it enters Stony Brook, and a house about 150 ft. upstream of the highway 6 ft. above the streambed. The following typical cross-section for this reach is based on field notes and USGS topo information.



The Stage-Normal Flow relationship for this reach is given on p. 14. The pre-failure flow of 414 cfs would create a stage of 2.3 ft. in this reach. The attenuation due to storage in the reach is calculated on p. 15. The attenuated peak dam failure flow at the confluence with Story Brook would be 6880 cfs, which would create a stage of 8.7 ft.

The house 150 ft. upstream of Highway 31 is 6-7 ft. above the streambed. Thus the peak dam failure flow would increase flooding from none to 2-3 ft. at this location. There would be some danger of loss of life at this location.

Highway 31 crosses the brook on an embankment with a 48" conduit:



According to FHWA "Hydraulic Engineering Circular No. 5", this culvert could carry about 80 cfs with the water surface at the roadway. Thus, before failure 414 - 80 = 324 cfs would flow over the road. After failure this would increase to about 6880 - 80 = 6800 cfs. This volume of flow, at the high velocities involved, would probably severely damage or destroy the embankment, rendering Highway 31 useless until repairs could be made.

The only other development in this reach is a bridge on a [illegible] road over [illegible] this bridge. The bridge would

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	1.0	13.0	16.3	0.8	11.2	84.8
2.00	2.0	32.0	22.6	1.4	40.3	306.2
3.00	3.0	57.0	29.0	2.0	89.5	680.1
4.00	4.0	88.0	35.3	2.5	161.8	1229.6
5.00	5.0	125.0	41.6	3.0	260.3	1977.6
6.00	6.0	168.0	47.9	3.5	387.7	2945.7
7.00	7.0	217.0	54.3	4.0	546.9	4155.2
8.00	8.0	272.0	60.6	4.5	740.5	5626.1
9.00	9.0	333.0	66.9	5.0	971.1	7378.0
10.00	10.0	400.0	73.2	5.5	1241.2	9429.7
11.00	11.0	480.0	93.3	5.1	1430.8	10870.5
12.00	12.0	580.0	113.4	5.1	1722.2	13084.8
13.00	13.0	700.0	133.5	5.2	2113.4	16056.8
14.00	14.0	840.0	153.6	5.5	2608.4	19817.1
15.00	15.0	1000.0	173.7	5.8	3213.5	24414.8
16.00	16.0	1180.0	193.8	6.1	3936.4	29906.8
17.00	17.0	1380.0	213.9	6.5	4784.9	36353.1
18.00	18.0	1600.0	234.0	6.8	5767.0	43814.7
19.00	19.0	1840.0	254.1	7.2	6890.7	52352.4
20.00	20.0	2100.0	274.2	7.7	8164.0	62026.3
21.00	21.0	2380.0	294.3	8.1	9594.6	72895.6
22.00	22.0	2680.0	314.4	8.5	11190.3	85018.5
23.00	23.0	3000.0	334.5	9.0	12958.4	98452.2
24.00	24.0	3340.0	354.6	9.4	14906.5	113252.6
25.00	25.0	3700.0	374.7	9.9	17041.7	129475.0
26.00	26.0	4080.0	394.8	10.3	19371.2	147173.4
27.00	27.0	4480.0	414.9	10.8	21902.0	166401.1
28.00	28.0	4900.0	435.0	11.3	24640.9	187210.5
29.00	29.0	5340.0	455.1	11.7	27594.8	209652.9
30.00	30.0	5800.0	475.2	12.2	30770.4	233779.3

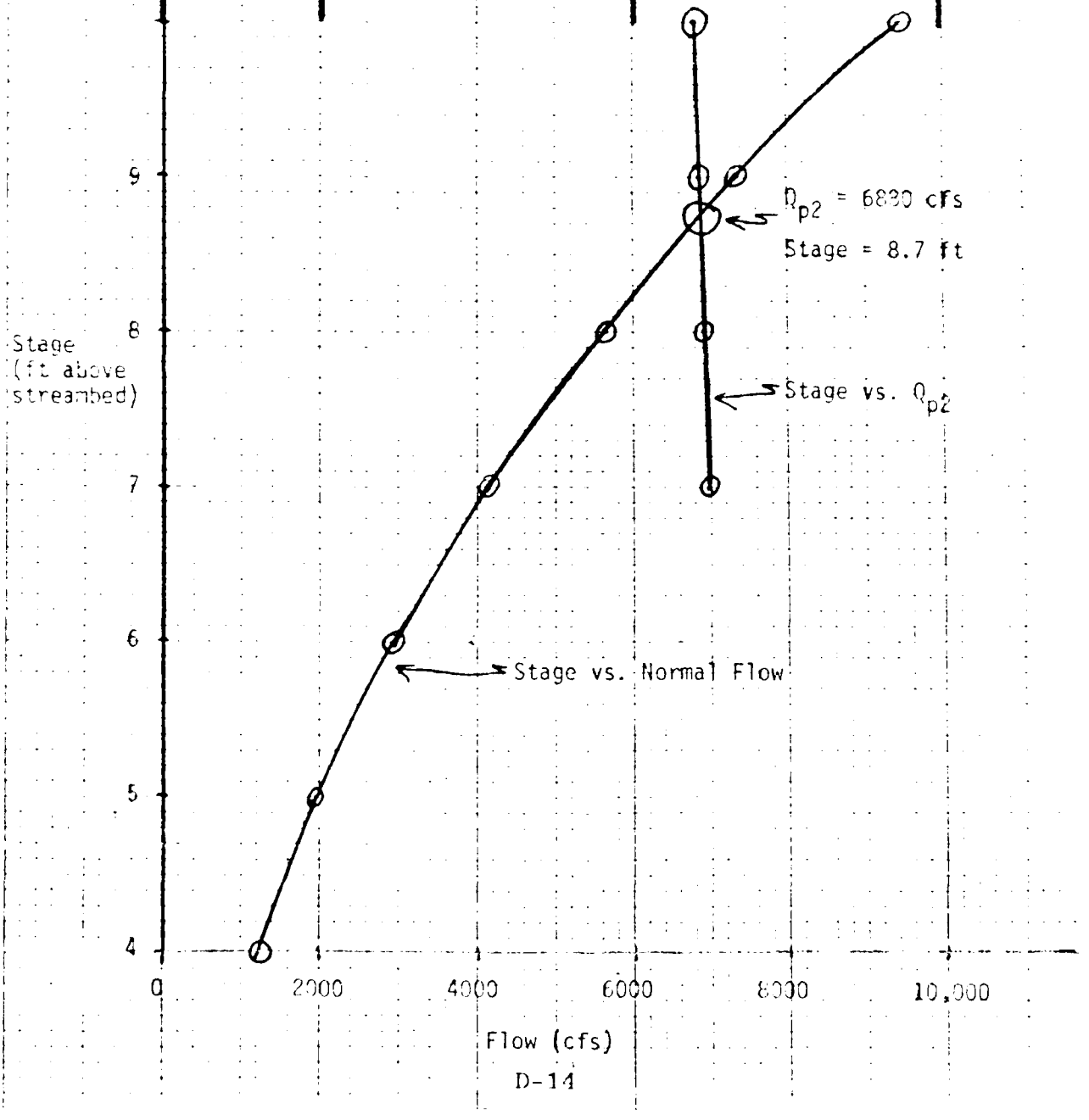
REACH FROM DAM TO CONFLUENCE WITH STONY BROOK

Attenuated Peak Dam Failure Flow at Confluence with Stony Brook

TCG, 6/25/79, p. 15

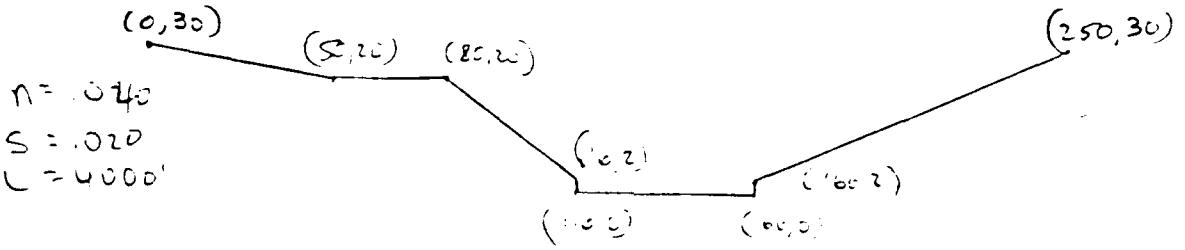
$$Q_{p2} = Q_{p1}\left(1 - \frac{STOR}{602}\right) = 7180\left(1 - \frac{STOR}{602}\right)$$

Stage (ft)	Area (above 2.3 ft) (sq ft)	Storage $\left(\frac{AREA \times 4000}{43{,}560}\right)$ (ac ft)	Q_{p2} (cfs)
7	178	16.3	6990
8	233	21.4	6930
9	294	27.0	6860
10	361	33.0	6790



be severely overtopped by the dam failure flow. The farm building is about 6 ft. above the streambed, and would also be damaged by flood flows.

For the next 4000 ft. to the town of Wilton, Stony Brook is paralleled by Highway 31. There is no other development in this reach. The following typical cross-section is based on field notes and U.S.G.S. topo information.



The Stage-Normal Flow relationship for this reach is given on p. 17. The pre-failure flow of 900 cfs (assuming 500 cfs inflow from Stony Brook) would create a stage of 2.1 ft. The attenuation due to storage in this reach is calculated on p. 18. The attenuated peak flow of 6,550 cfs yields a stage of 7 ft, which would not reach the highway. This flow does not include any assumed inflow from Stony Brook, which would make dam failure flows higher and increase downstream damages. If the inflow is on the order of 500 cfs this increase would not be large.

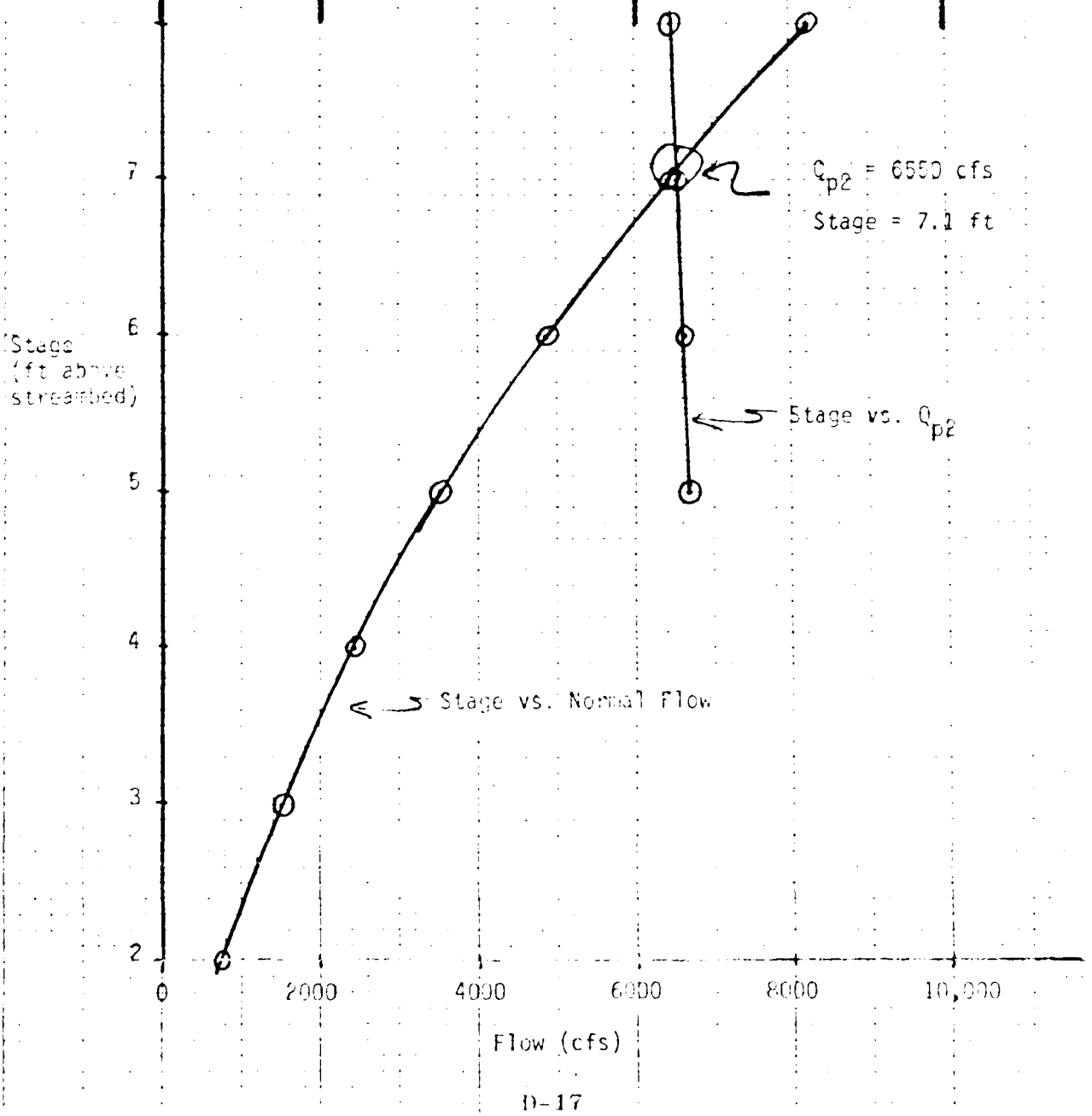
At the outskirts of Wilton, Stony Brook becomes much less steep. The brook is paralleled by Highway 31 and there is a row of houses between the highway and the brook. The first floor of these houses is quite close to the stream. There are nine houses with first floors 7'-12' above the streambed, and two about 18 feet above. There is also an apartment building

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	1.0	50.0	52.0	1.0	48.7	256.6
2.00	2.0	100.0	54.0	1.9	150.8	794.6
3.00	3.0	152.5	59.4	2.6	286.0	1506.8
4.00	4.0	210.0	64.8	3.2	460.1	2423.7
5.00	5.0	272.5	70.2	3.9	673.4	3547.4
6.00	6.0	340.0	75.6	4.5	926.9	4882.8
7.00	7.0	412.5	81.0	5.1	1221.7	6436.1
8.00	8.0	490.0	86.4	5.7	1559.3	8214.4
9.00	9.0	572.5	91.8	6.2	1941.0	10225.2
10.00	10.0	660.0	97.2	6.8	2368.3	12476.3
11.00	11.0	752.5	102.6	7.3	2842.8	14975.6
12.00	12.0	850.0	108.0	7.9	3365.8	17731.0
13.00	13.0	952.5	113.4	8.4	3939.0	20750.5
14.00	14.0	1060.0	118.8	8.9	4563.8	24042.1
15.00	15.0	1172.5	124.2	9.4	5241.8	27613.6
16.00	16.0	1290.0	129.6	10.0	5974.4	31473.0
17.00	17.0	1412.5	135.0	10.5	6763.2	35628.1
18.00	18.0	1540.0	140.4	11.0	7609.5	40086.6
19.00	19.0	1672.5	145.8	11.5	8514.9	44856.2
20.00	20.0	1810.0	151.2	12.0	9480.8	49944.5
21.00	21.0	1984.0	189.4	10.5	9504.8	50070.6
22.00	22.0	2166.0	197.7	11.0	10693.4	56332.4
23.00	23.0	2356.0	206.0	11.4	11971.0	63062.7
24.00	24.0	2554.0	214.2	11.9	13340.1	70275.0
25.00	25.0	2760.0	222.5	12.4	14803.2	77982.6
26.00	26.0	2974.0	230.7	12.9	16362.8	86198.6
27.00	27.0	3196.0	239.0	13.4	18021.4	94935.8
28.00	28.0	3426.0	247.3	13.9	19781.4	104207.1
29.00	29.0	3664.0	255.5	14.3	21645.1	114025.1
30.00	30.0	3910.0	263.8	14.8	23614.9	124402.2

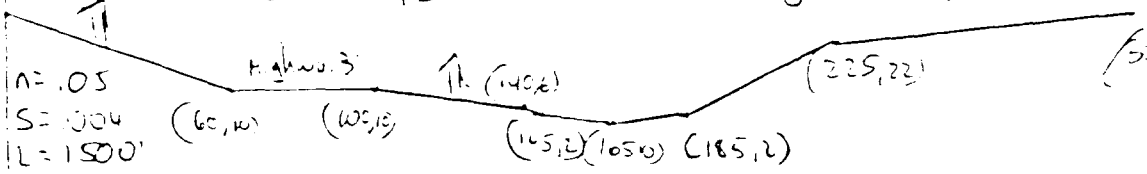
REACH FROM CONFLUENCE WITH STONY BROOK TO WILTON

$$Q_{p2} = Q_{p1}\left(1 - \frac{STOR}{602}\right) = 6880\left(1 - \frac{STOR}{602}\right)$$

Stage (ft)	Area (above 2.1 ft) (sq ft)	Storage $\left(\frac{AREA \times 4000}{43,560}\right)$ (ac ft)	Q_{p2} (cfs)
5	167	15.4	6700
6	235	21.6	6630
7	307	28.2	6560
8	385	35.3	6480



about 12' above the streambed and a laundry about 10 ft. up. Across Highway 31 there are numerous (20+) houses and businesses about 25 ft. above the streambed. The cross-section for this reach given below is based on field notes and U.S.G.S. top information. This reach runs 1500' to the confluence of Stony Brook and the Saukegan River.



The stage-Normal Flow relationship for this reach is given on p. 20. The pre-failure flow of 900 cfs would create 5.5 ft. of flow in the channel. The attenuation due to storage in this reach is calculated on p. 21. The attenuated peak failure flow of 6250 cfs yields a stage of 13.1 ft.

The failure of S.R.W. Dam #33 would increase flooding from none to 1-6 ft. at the 9 low-lying houses. It would also cause 1ft of flooding at the apartment building, and 3 ft. at the laundry. This would present a serious threat of loss of life, especially in the houses. It would also flood and possibly damage Highway 31 in this area. Downstream of the residences and still in the town of Wilton, Stony Brook passes over Abbot Memorial Trust Dam and flows into the Saukegan. The resulting flow

DEPTH	ELEV	AREA	WPER	HYD-R	AR2/3	Q
0.00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	1.0	10.0	20.1	0.5	6.3	11.8
2.00	2.0	40.0	40.2	1.0	39.9	75.1
3.00	3.0	81.6	44.0	1.9	123.2	232.2
4.00	4.0	126.5	47.9	2.6	241.9	455.8
5.00	5.0	174.6	51.7	3.4	393.2	741.1
6.00	6.0	226.0	55.5	4.1	576.2	1086.1
7.00	7.0	285.0	67.8	4.2	742.4	1399.3
8.00	8.0	356.0	80.1	4.4	962.7	1814.4
9.00	9.0	439.0	92.4	4.8	1241.3	2339.5
10.00	10.0	534.0	104.7	5.1	1583.2	2983.9
11.00	11.0	677.5	150.1	4.5	1851.4	3489.4
12.00	12.0	826.0	155.5	5.3	2516.2	4742.3
13.00	13.0	979.5	160.9	6.1	3267.8	6158.9
14.00	14.0	1138.0	166.3	6.8	4104.7	7736.2
15.00	15.0	1301.5	171.7	7.6	5025.9	9472.5
16.00	16.0	1470.0	177.1	8.3	6031.0	11366.7
17.00	17.0	1643.5	182.5	9.0	7119.7	13418.5
18.00	18.0	1822.0	187.9	9.7	8292.0	15628.1
19.00	19.0	2005.5	193.3	10.4	9548.3	17995.8
20.00	20.0	2194.0	198.7	11.0	10888.8	20522.4
21.00	21.0	2387.5	204.1	11.7	12314.2	23208.7
22.00	22.0	2586.0	209.5	12.3	13824.9	26056.1
23.00	23.0	2793.5	222.7	12.5	15094.6	28449.1
24.00	24.0	3014.0	235.9	12.8	16486.5	31072.4
25.00	25.0	3247.5	249.1	13.0	18003.7	33932.0
26.00	26.0	3494.0	262.3	13.3	19649.9	37034.4
27.00	27.0	3753.5	275.5	13.6	21428.5	40386.6
28.00	28.0	4026.0	288.7	13.9	23343.3	43995.6
29.00	29.0	4311.5	302.0	14.3	25398.2	47868.5
30.00	30.0	4610.0	315.2	14.6	27597.0	52012.5

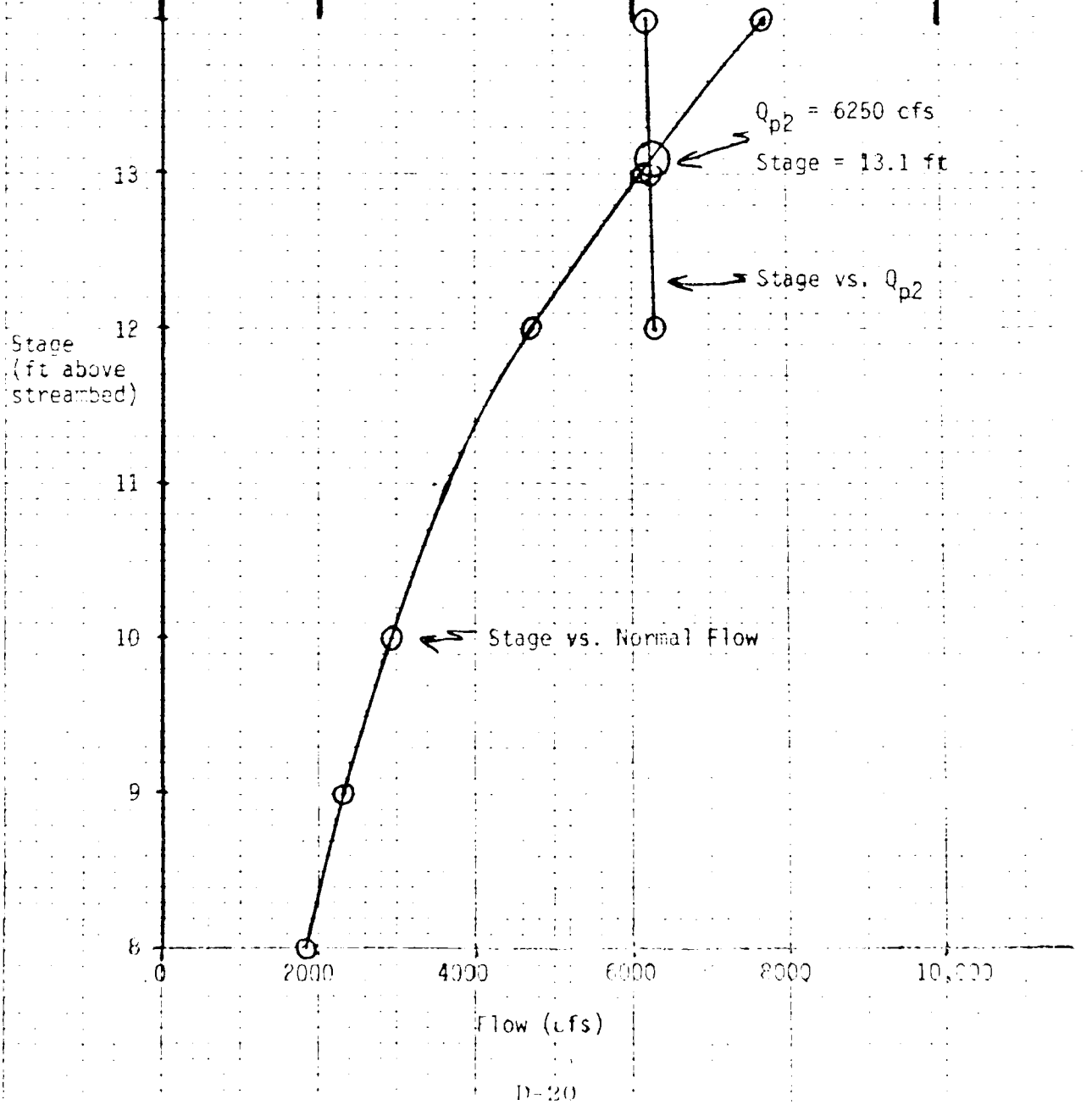
REACH THROUGH WILTON

Attenuated Peak Dam Failure Flow at the Confluence of Stony Brook and the Souhegan River

TCG, 6/25/79, p. 21

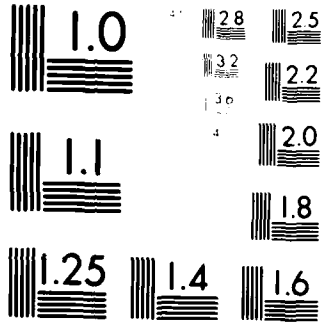
$$Q_{p2} = Q_{p1}\left(1 - \frac{STOR}{602}\right) = 6550\left(1 - \frac{STOR}{602}\right)$$

Stage (ft)	Area (above 5.5 ft) (sq ft)	Storage ($\frac{AREA \times 1500}{43{,}560}$) (ac ft)	Q_{p2} (cfs)
12	626	21.5	6320
13	779	26.8	6260
14	938	32.3	6200



AD-A156 442 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS SOUHEGAN RIVER WATERS..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV AUG 79 2/2

UNCLASSIFIED F/G 13/13 NL



in the Souhegan would depend on antecedent flow conditions in the River. Stony Brook would contribute a peak dam failure flow of 6250 cfs (5350 cfs above pre-failure flow). This could affect the 5-10 homes and businesses along the Souhegan in Wilton, although dam failure flows would attenuate rapidly. Downstream of Wilton the Souhegan flows through about 5 miles of broad flood plain before reaching the town of Milford. It is expected that the dam failure outflow would essentially be attenuated in this reach.

The following chart summarizes the downstream impacts of the failure of Souhegan R.W. Dam #33

Location # (Map, p.9)	Location	# of dwellings	level above streambed (ft.)	Flow and Stage Before failure	Flow and Stage After failure	comments
–	tailwater	–	–	414 cfs 682' MSL	7180 cfs –	Dale St. overtopped.
①	Highway 31, house, Stony Brk	1	6-7	414 cfs 2.3 ft	6880 cfs 8.7ft.	Some danger of loss of life. Highway 31 severely overtopped
②	houses @ Wilton	9 2 1 apt. house 1 laundry	7 18 12 10	900 cfs 5.5ft	6250 cfs 13.1 ft.	Danger of loss of life. Highway 31 severely (3') overtopped
③	Souhegan R. Confluence	–	–	900 cfs	6250 cfs	
	Souhegan R. downstream	10-15	varies	–	–	possible freeboard problems

Test Flood Analysis

Size Classification: SMALL

HAZARD Classification: HIGH

The hazard classification is HIGH due to the potential for serious economic losses and loss of life along Stony Brook in Wilton and at other locations in the event of dam failure (see chart, p. 22).

TEST FLOOD: 1/2 PMF to PMF.

When a range of possible test flood inflows is suggested, the COE's "Recommended Guidelines" advise using the inflow most closely relating to the dam's hazard potential. Since the hazard potential is on the high side of high, the Test Flood is the PMF.

Using the COE NED "Maximum Probable Flood Peak Flow Rates", the upstream drainage area of 1.0 square miles with rolling terrain would yield a peak PMF inflow of 2125 csm.

Peak inflow = (1)(2125) = 2125 cfs

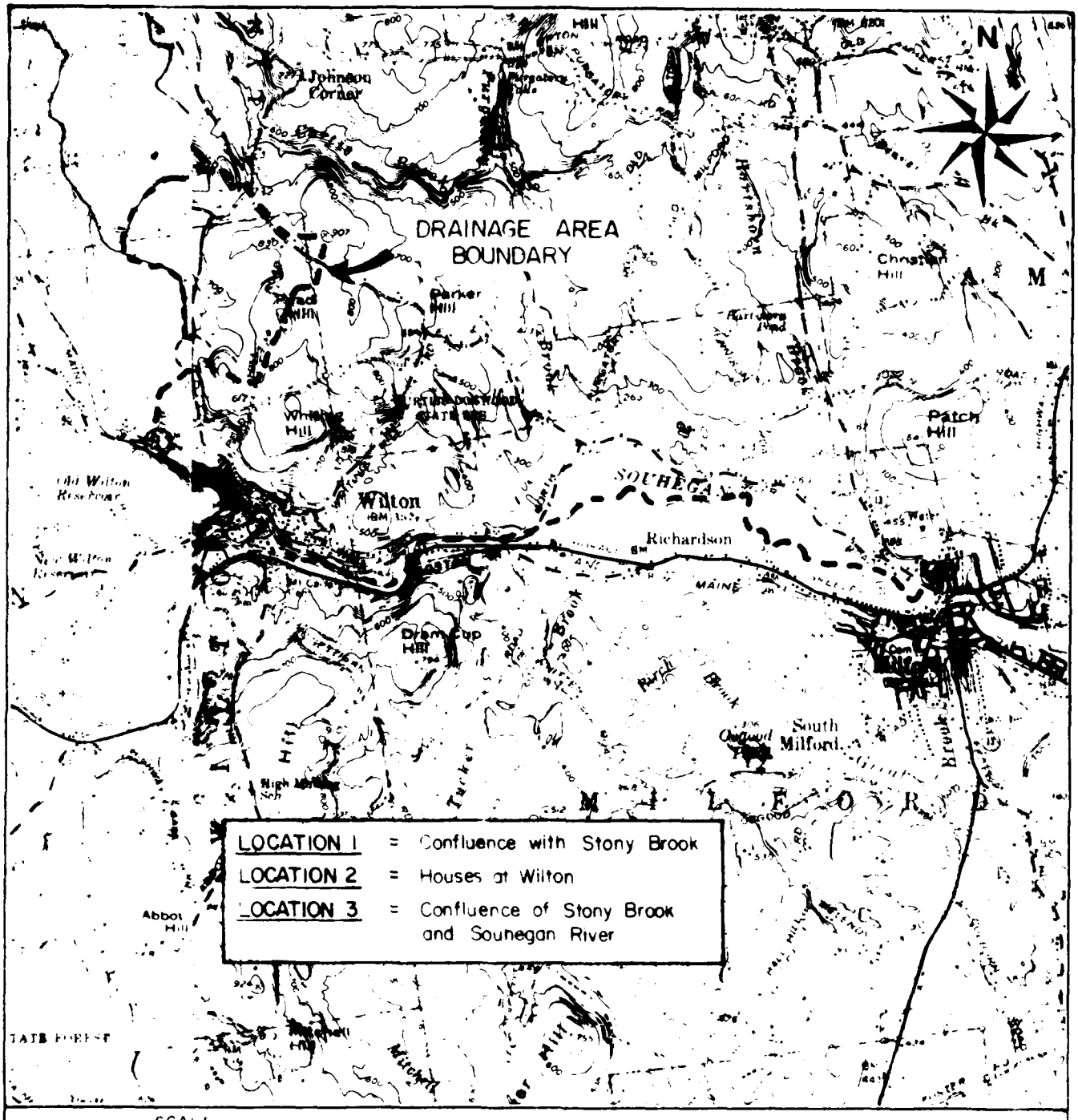
The SCS "Freeboard Hydrograph" (approximately equivalent to the PMF) is 1728 cfs. Their routed peak outflow (storage routed) is 662 cfs, which would yield a water surface elevation of 695.8 ' MSL.

Since the test flood generated by the COE methodology is larger (and therefore more conservative), that is the Test

Flood inflow. Attenuation by storage in the reservoir is calculated on p. 25. The attenuated peak test flood outflow is 1080 cfs, which yields an elevation of 696.7 ft MSL, 15.7 ft. above the low flow outlet and 1.5 ft. below the top of the dam.

Drawdown Time

According to the SCS "Hydrology and Hydraulics" Calculations, the 10-day drawdown elevation is 690.5 ft. MSL.



SCALE

1/2 1 2(Miles)

FROM USGS MILFORD AND PETERBOROUGH N.H. QUADRANGLE MAP

GOLDBERG, ZOINO, DUNNICLIFF & ASSOC., INC.
GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

SOUHEGAN RIVER
WATERSHED DAM No 33 NEW HAMPSHIRE

FILE No 22001

SCALE AS NOTED
DATE MAY 1979

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY	MO	YR
NH	265	NED	NH	011	02				SOUHEGAN RIVER WATERSHED DAM NO 33	4251.6	7145.0	30	JUL	79

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	05	KING BROOK	WILTON	1	2276

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE FT.)	(27) NORMAL (ACRE FT.)	DIST	DWN	FED R	PRV/FED	SCS A	VER/DATE
PGRE	1973	C	21	21	900	24	NED	N	N	N	B	

(28) REMARKS

(29) D/S HAS	(30) SPILLWAY CREST LENGTH (FT.)	(31) TYPE	(32) WIDTH (FT.)	(33) MAXIMUM DISCHARGE (FT.)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) PROPOSED (MW)	(37) NAVIGATION LOCKS NO	(38) LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
1	510	U	102	2100	32400											

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
NH WATER RESOURCES BOARD	USDA SCS	

(49) REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

(50) INSPECTION BY	(51) INSPECTION DATE DAY | MO | YR	(52) AUTHORITY FOR INSPECTION
GOLDBERG ZOINO DUNNICLIFF + ASSOC	14MAY79	PUBLIC LAW 92-367

(53) REMARKS

END

FILMED

8-85

DTIC